

A Coastal Floodplain Management Plan
for
Gloucester County, Virginia



A Coastal Floodplain Management Plan for Gloucester County, Virginia

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Adopted by Gloucester County Board of Supervisors on September 1, 2009.

Executive Summary

Purpose

The purpose of the plan is to analyze the causes of flooding in Gloucester County and identify the vulnerabilities due to flooding within the community. The plan also documents and analyzes the county's existing flood management practices and provides feasible solutions to strengthen the county's overall flood management system, helping to lessen the amount of damage caused by flooding.

During the development of this plan a standard 10-step process was followed. The 10 steps are based on the Federal Emergency Management Agency (FEMA) guidelines and requirements for the Community Rating System (CRS) Program for the development of a floodplain management plan.

Table 1: Community Rating System Planning Steps

Planning Process
1) Organize to Prepare the Plan
2) Involve the Public
3) Coordinate with Other Agencies
Risk Assessment
4) Assess the Problem
5) Assess the Hazard
Mitigation Strategy
6) Set goals
7) Review Possible Activities
8) Draft an Action Plan
Plan Maintenance
9) Adopt the Plan
10) Implement, Evaluate, and Revise

Source: FEMA, 2006

Organize to Prepare the Plan

At the beginning of this plan's conception a six person planning committee was formed to guide the planning process. The committee was made up of Paul Koll, Gloucester County Building Official, Christopher Perez, Gloucester County Planner and then Urban and Regional Planning Graduate Student at VCU, Dr. Mort Gulak and Dr. Avrum Shriar, Professors of Urban Studies and Planning at VCU, as well as Jay Scudder, former Director of Planning, and Mark Westfall, former Emergency Management Coordinator. The committee initially convened on **January 25, 2007** to discuss: the role of the committee in the formation of the plan and to schedule follow up meetings to discuss the plan's progress. The committee also discussed the parameters of the plan, various resources to aid in the risk assessment of the area, the agencies that needed to be involved, the extent that the public would be involved, as well as the time frame for the plan's completion and projected adoption date.

During the initial research and data gathering phase of the plan, committee members provided guidance and assistance as needed. The committee officially convened five times throughout the year and between formal meetings the committee remained in

contact through e-mail and phone. The second official committee meeting was held on **April 18, 2007** at which members discussed the work that had been done thus far. The meeting also served as a brain storming session that provided suggestions for improvements to existing ideas and suggested additional information that needed to be included in the plan.

The third meeting, held on **May 2, 2007**, focused mainly on formulating goals and solidifying objectives for the plan. During the first week in **August 2007**, a working draft of the plan was given to all the committee members for review, and by **September 2007**, each member had provided feedback. By **December 2007** a draft plan was completed. The draft plan was presented to the Gloucester County Planning Commission in **April 2008**. The Commission asked to review the plan once it had been accepted by the ISO review board. The ISO review was received late **April 2008**, and the draft plan was revised per ISO recommendations and suggestions. In **May 2009**, the Board of Supervisors passed a resolution directing the Planning Department with assistance from the Department of Codes Compliance to develop a Floodplain Management Plan for the County by **November 2009**. The resolution also approved the formation of an annual review committee whose 16 members will be made up of landowners, residents and business owners of the flood prone area, BOS members, and staff from various county offices. For a copy of the resolution, see Appendix H.

Public Involvement

During the development of this plan three public meetings were held in the community for the purpose of informing the public and gaining feedback from Gloucester County citizens about the current coastal flooding problem in their county, the first on **May 10, 2007**, the second on **October 23, 2007**, and the third on **May 14, 2009**. Citizens of Gloucester County were notified of the public meetings via advertisements in the *Gloucester Mathews Gazette Journal* (a local newspaper), see Appendix G. Four of the six planning committee members (County Staff) were the official presenters at the meetings.

The meetings were held at Achilles Elementary School, a school that is located in the floodplain and in close proximity to the majority of the county's repetitive loss areas. During the first two meetings, a Flood Protection Questionnaire (see Appendix A) was dispensed to survey attending citizens about their personal experiences with flooding in the community, as well as to gauge their general level of education about the flooding hazard of the area. Attending residents were notified of the county's current involvement with the National Flood Insurance Program (NFIP) and its CRS program, a brief history of the county's flooding problem, the existing flood mitigation strategies as well as suggested recommendations in the plan. Open discussion was encouraged in order to formulate new policies and strengthen existing strategies that would improve the area's flooding problem. For the minutes from the first meeting, see Appendix G.

At the third public meeting the Draft Floodplain Management Plan was presented, reviewed, and discussed. The draft plan was available for citizen review through the County website, as well as in the Planning Department. At the meeting each of the suggested recommendations in the plan was discussed. Citizen comment and suggestions were obtained from this meeting and utilized to revise the draft plan before presenting the plan to the Planning Commission for review at their **June 2009** meeting. At the meeting the Planning Commission asked to set a Public Hearing for the **July 2, 2009** meeting.

During the **July 2, 2009** meeting of the Planning Commission a public hearing was held regarding the proposed Floodplain Management Plan. The Planning Commission voted 11-0 (with two absent) to forward the Plan to the Board of Supervisors with a recommendation of approval. At the **September 1, 2009** meeting of the Board of Supervisors a public hearing was held regarding the proposed plan.

Coordination with Other Agencies

The plan has been developed with information from communications with the following local, regional, state and federal agencies/ organizations. In **April 2009**, staff sent the draft plan to all of the following agencies (except agencies in *italics*) requesting comments. Comments were obtained from these agencies and utilized to revise the draft plan before presenting the plan to the Planning Commission for review at their **June 2009** meeting.

Gloucester County

Department of Planning
Department of Codes and Compliance
Department of Emergency Services
Department of Information Technology (GIS)
Department of Community Education
Department of Public Utilities
Department of Public Works
Department of Social Services
Sheriff's Office
Public Library
Volunteer Fire and Rescue (Abingdon and Gloucester)

Non Profit Organizations

Bay Aging, Inc.
Friends of the Library

Private Companies

Dominion Virginia Power

Neighboring Communities

York County
City of Portsmouth

Regional Agencies

Middle Peninsula Planning District Commission
Tidewater Soil Water Conservation District
Hampton Roads Emergency Management Committee

State Agencies

Virginia Department of Conservation & Recreation
Virginia Department of Transportation
Virginia Department of Emergency Management
Virginia Department of Environmental Quality
Virginia Department of Health

Federal Agencies

FEMA's Community Rating System (Insurance Services Office Inc)
Federal Emergency Management Agency, Region III (VA)

Data Analysis

To determine the causes and areas most affected by flooding within the county, the plan documents and analyzes:

- Past seasonal coastal storm events that have affected the county and nearby areas
- County Storm Surge Map
- County Flood Insurance Rate Maps (FIRM)
- County elevation profiles

Complete assessment of community vulnerabilities requires analysis of the following factors:

- Repetitive loss properties
- Pre - FIRM structures in Special Flood Hazard Area (SFHA)
- Vulnerable populations
- Safety hazards
- Critical facilities

Recommendations

The plan documents and analyzes the existing mitigation strategies for Gloucester County and provides feasible recommendations for improving of these tactics. The plan recommends that the county:

- Adopt the Floodplain Management Plan to help strengthen the community's mitigation activities as well as to help lower insurance premiums for policy holders (Section 5.3b).
- Utilize the road improvement priority list to prioritize the allocation of scarce resources to projects that support the largest number of unmitigated pre-FIRM structures in the SFHA (Section 5.1b1).
- Continue to monitor State Route 649, Maryus Road and if washouts from flooding persist, improve the road to withstand coastal floodwaters by elevating damaged sections and installing more appropriate roadway drainage crossings (Section 5.1b2).
- Develop a semiannual ditch maintenance program for the southeastern portion of the county (Section 5.1b3).
- Keep detailed records of which roads in the county flood, how often and to what extent (Section 5.1b4).
- Consider permanent road signage with gauges that mark high water on frequently flooded roads in the county (Section 5.1b5).
- Seek to acquire properties through a voluntary program according to the priority list in order to increase the amount of land preserved as open space, and to reduce the amount of flood damage to new and existing properties in the flood prone areas of the community (Section 5.3a).

-
- Adopt a voluntary cellular telephone directory, which will work in unison with the existing reverse 911 system (Section 5.5b1).
 - Install an outdoor emergency warning system within the flood prone southeastern portion of the county (Section 5.5b2).
 - Send annual mass mailings with specialized information relating to property protection, flood safety and flood insurance to owner of property in a flood zone (Section 5.4a).
 - Provide a central location where general information on flood preparedness, flood insurance, and floodplain management is easily accessible to the public in a hard copy format (Section 5.4b).
 - Advertise the technical assistance opportunities provided by County in relation to flood mitigation and preparedness, preferably in the same central locations where other flood-hazard information is available (Section 5.4c).
 - Assist residents with existing fuel, oil and propane tanks that are not secured by providing tie-down assistance (Section 3.4).
 - Examine the public health, safety and economic impacts associated with the increased use of alternative septic systems in flood prone areas (Section 3.4).
 - Evaluate the potential impact of climate change on the community, particularly with respect to its wetlands, and consider potential management options (Section 2.4).
 - Develop a Storm Water Management Plan that will help regulate storm water throughout the county (5.6a).
 - Continue to zone for low density development and encourage residential clustering within flood-prone areas (Section 5.2a).
 - Continue to enforce building regulations throughout the county (Section 5.2b).
 - Continue to require and enforce the provisions of the Floodplain Management Ordinance (Section 5.2c).
 - Continue to enforce the Chesapeake Bay Preservation Ordinance, Erosion and Sediment Control Ordinance, and the Wetland Zoning Ordinance (Section 5.6).
 - Continue to regularly inspect the County's high hazard dam and perform regular maintenance on it, as well as continue participation in the National Dam Safety Program (Section 5.1a).
 - Continue to utilize its existing severe weather and hazard identification process (Section 5.5b).

This plan does not commit Gloucester County to any of the suggested mitigation remedies; it is merely a guide for local officials to use when making decisions about floodplain management within the community.

Table of Contents

Executive Summary.....	i
Purpose.....	i
Organize to Prepare the Plan.....	i
Public Involvement	ii
Coordination with Other Agencies.....	iii
Data Analysis	iv
Recommendations.....	iv
1. Introduction.....	1
2. Assess the Hazard: Potential Causes of Flooding in Gloucester County.....	3
2.1 Coastal Flooding.....	3
2.2 Storm Surge.....	6
2.3 History of Hurricane Events in the area.....	7
2.4 Climate Change.....	9
2.5 Riverine Flooding.....	9
2.6 Dam Impoundments.....	10
3. Assess the Problem: Vulnerability of the Community.....	13
3.1 Property Damage	13
3.2 Vulnerable Populations.....	22
3.3 Critical Facilities.....	23
3.4 Safety and Health Hazards.....	28
4. Goals.....	32
5. Hazard Mitigation Activities.....	33
5.1 Structural Improvement Activities	33
The Beaverdam Reservoir.....	33
Road Improvements.....	34
5.2 Preventative Activities	42
Planning and Zoning.....	43
Building Regulations.....	47
Floodplain Development Regulations.....	47
5.3 Property Protection Activities.....	48
Elevation and Acquisition Projects	49
Purchasing Flood Insurance.....	52
5.4 Public Information Activities.....	53
Community Educational Outreach Project.....	53
Public Libraries and the County Website.....	55
Technical Assistance and Map Information.....	56
5.5 Emergency Services Measures.....	56
Hazard Identification.....	57
Warning.....	57
5.6 Natural Resource Protection	61
6. Action Plan.....	62
7. Plan Adoption.....	68

List of Tables

Table 1: Community Rating System Planning Steps.....	i
Table 2: Storms within 65 nm of Gloucester County between 1980 and 2007.....	4
Table 3: Storms within 100 nm of Gloucester County between 1980 and 2007.....	5
Table 4: Dams in Gloucester.....	11
Table 5: Repetitive Loss Areas.....	21
Table 6: Road Closures Due to Flooding from 1999 - 2006.....	26
Table 7: Road Closures Due to Flooding from 1999 - 2006.....	37
Table 8: Zone Lot Size Requirements.....	46
Table 9: Development Provisions for Flood Districts.....	48
Table 10: Suggested Repetitive Loss Acquisition Priority List.....	52

List of Figures

Figure 1: Gloucester County Regional Context.....	1
Figure 2: Storms within 65 nm of Gloucester County between 1980 and 2007.....	4
Figure 3: Storms within 100 nm of Gloucester County between 1980 and 2007.....	5
Figure 4: A Nor'easter off the United States Eastern Coast.....	6
Figure 5: Illustration of a Storm Surge	6
Figure 6: Beaverdam Flood Inundation Map.....	12
Figure 7: Typical landscape of SE Gloucester County	13
Figure 8: Gloucester Elevation Profile.....	14
Figure 9: Gloucester County Flood District Map.....	16
Figure 10: Gloucester County Census Block Groups.....	18
Figure 11: Gloucester County Storm Surge	19
Figure 12: Critical Facilities in the Southeastern Portion of Gloucester County.....	27
Figure 13: Depiction of VDOT Prescribed Roadway Section	34
Figure 13a: Depiction of Roadway Section at 2339 Low Ground Road.....	35
Figure 13b: Depiction of Roadway Section at Haywood Seafood on Maryus Road.	35
Figure 13c: Depiction of Roadway Section at 10021 Maryus Road.....	35
Figure 14: Roadway Drainage Crossing in the Southeastern Portion of the county	36
Figure 15: Roadside Ditch in the Southeastern Portion of the county.....	36

Figure 16: Example of Damaged Roadway Drainage Crossing.....	36
Figure 17: Example of a Clogged Culvert Caused by a Wide Inlet.....	36
Figure 18: Culvert Inlet that Maintains Natural Channel Configuration.....	37
Figure 19: Gloucester County Road Prioritization Map.....	40
Figure 20: Example of a Roadside Flood Gauge.....	42
Figure 21: Gloucester County Zoning Map.....	44
Figure 22: Gloucester County Zoning (Southeastern Portion Inset) Map.....	45
Figure 23: Clustering Inland.....	46
Figure 24: Clustering on the Coast.....	47
Figure 25: Typical Residential Elevation within a VE and V Zone.....	49
Figure 26: Typical Residential Elevation within an AE and A Zone.....	49
Figure 27: Emergency Siren Proposed Locations Map.....	60

1. Introduction

Gloucester County is located in the southeastern portion of Virginia's Middle Peninsula within close proximity of the Chesapeake Bay. Half of the county's 140,364 acres are bounded by two tidal rivers and the Mobjack Bay: York River on the south and the Piankatank River on the north (Figure 1). The county serves as a bedroom community for neighboring Virginia Peninsula localities (Newport News, Hampton, York County, and Williamsburg). According to the 2000 census, there are approximately 14,494 housing units in the county and approximately 34,780 residents. During a decennial growth spurt in the 1980s, there was pressure to develop on the area's low lying coastal land, much of which has elevations ranging from zero to five feet above mean sea level.

Gloucester County's proximity to the Chesapeake Bay and numerous tidal rivers, coupled with the area's low elevation, create an area with high risk of coastal flooding in the event of a seasonal coastal storm. Depending on the storm's magnitude and proximity to the county, coastal flooding can threaten public safety and local economic viability (FEMA 1987, 2-4).

Figure 1: Gloucester County Regional Context



Source: Google Maps

Over the years the county has taken many steps to protect its citizens from the area's flooding hazards. The county has implemented a number of preventative measures, property protection policies, public information activities, and emergency service measures in an attempt to decrease the flood hazard's impact on the community.

From 1983 to 1987, the Federal Emergency Management Agency (FEMA) investigated the flood hazards in Gloucester County. This investigation yielded the county's Flood Insurance Study (FIS) and Flood Insurance Rate Map (FIRM), both of which are used to develop flood risk data for the community and establish flood insurance rates throughout the region. The FIRM depicts flooding during a 100-year storm event (storms that have a 1% chance of being equaled or exceeded in any given year). The FIRM accounts for both storm surge driven flooding, as well as flooding caused by heavy rainfall. The map

provides base flood elevations for the entire county derived from a detailed hydraulic analysis of the area described in the FIS. The map also provides flood zone designations for the entire county describing the type of flooding experienced.

In 1987, Gloucester became a participating community in FEMA's National Flood Insurance Program (NFIP); this enabled citizens to obtain federally backed flood insurance. Via participation in the NFIP, Gloucester was eligible to join the Community Rating System (CRS) program. While participation in the CRS program is voluntary, the benefits for citizens in participating localities are numerous. Under the program, flood insurance premiums are modified based on a point system which calculates the community's efforts to reduce future flood damage in the area beyond the minimal national standards. These points are used to calculate a community's "Class Rating"; the rating is based on a scale of ten: 10 rating being the worst and 1 rating being the best. In 1994, FEMA conducted an analysis of the county's floodplain management efforts, and in 1995 awarded the County a Class 9 rating in the CRS program. Currently the rating directly affects the annual premiums of approximately 1,528 flood insurance policy holders within Gloucester County by decreasing premiums 5 percent. Due to the amount of repetitively flooded properties in the county, adoption of a floodplain management plan is **required** in order to continue to be eligible for the CRS program. To gain further reductions in flood insurance policy premiums the county must gain credits that will qualify the locality for a lower CRS rating. One method of acquiring CRS credit is through the development of a floodplain management plan for the county.

The purpose of this plan is to document and analyze the county's existing flood management practices and provide feasible recommendations to strengthen the county's overall flood management system, which may lessen the amount of damage caused by flooding.

2. Assess the Hazard: Potential Causes of Flooding in Gloucester County

2.1 Coastal Flooding

The county is threatened year-round by three major seasonal coastal storm events: hurricanes, tropical storms, and nor'easters – all of which, historically, have been the main causes of coastal flooding in the county. Nationwide besides fire, coastal flooding causes nearly 90% of Presidential Disaster Declarations. This type of flooding is typically a result of storm surge, wind driven waves, and heavy rainfall.

A hurricane is the most severe type of storm that can affect Gloucester County bringing with it extremely high winds, large amounts of rainfall, and storm surge. The storm surge caused by a hurricane carries with it the greatest potential to cause damage to coastal communities because of its ability to travel inland. Hurricanes are most likely to affect the region from June to November (FEMA 1987, 5).

Hurricanes and Tropical Storms

Hurricanes and tropical storms are closely related events being differentiated by their wind speed. Hurricane intensity is tracked and measured by the National Oceanic Atmospheric Association's (NOAA) National Hurricane Center (NHC) in Miami, Florida and they are graded using the Saffir-Simpson Hurricane Damage Scale (see Appendix D). Tropical storms are upgraded to hurricanes if sustained wind speeds reach 74 mph. In 1987, the Norfolk District of the U.S. Army Corps of Engineers tracked all the tropical storms of hurricane force which passed within 250 miles of the county; the average was determined to be one storm per year (FEMA 1987, 3-4).

The National Hurricane Center uses the measurement of a 65 nautical mile (nm) radius to signify that a particular location has experienced a direct hit from a storm, and the 100 nm radius to show events that narrowly missed the area but still had an impact through wave action and strong winds. The two figures below show every major storm event that has passed within close radius of Gloucester County between 1980 and 2007. Figure 2 and Table 2 show storms that passed within a 65 nm radius of the county:

Figure 3 and Table 3 show storms that passed within a 100 nm radius of the county. Within the 27 year time frame, twice as many storms were classified as having narrowly missed Gloucester County than those directly hitting the county.

Figure 2: Storms within 65 nm of Gloucester County between 1980 and 2007



Source: NOAA CSC Hurricane Mapping Tool

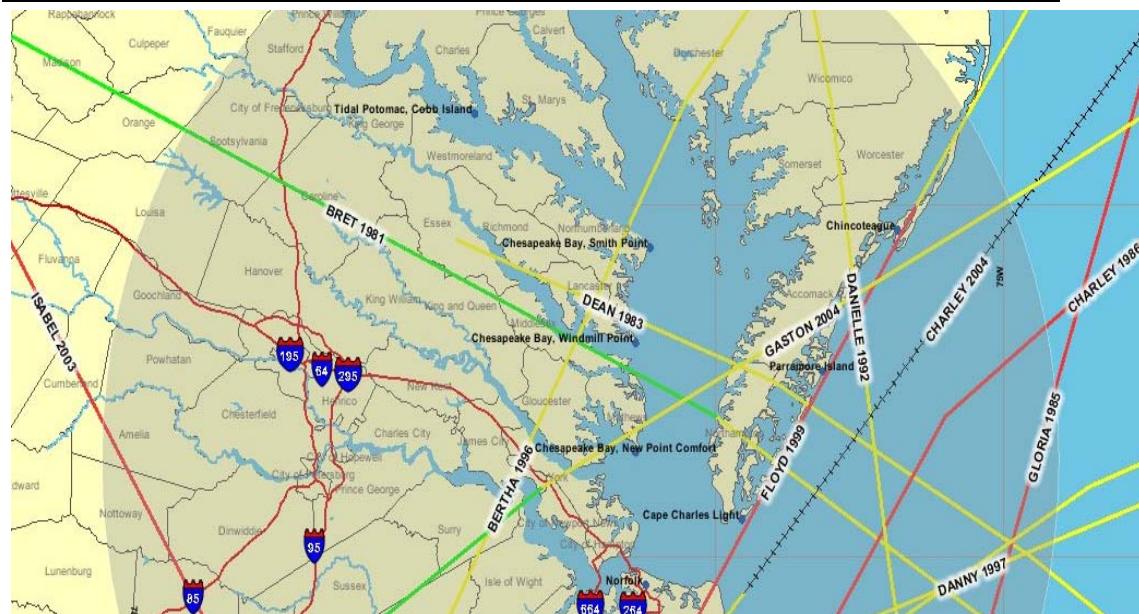
Note: Category 1-2 Hurricane (shown in Red Lines), Tropical Storm (shown in Yellow Lines, Green Lines, and Black Thatched Lines)

Table 2: Storms within 65 nm of Gloucester County between 1980 and 2007

YEAR	MONTH	DAY	STORM NAME	WIND SPEED (KTS)	CATEGORY
1981	7	1	BRET	50	Tropical Storm
1983	9	30	DEAN	55	Tropical Storm
1983	9	30	DEAN	40	Tropical Storm
1986	8	17	CHARLEY	65	Hurricane Cat 1
1986	8	18	CHARLEY	70	Hurricane Cat 1
1992	9	25	DANIELLE	55	Tropical Storm
1996	7	13	BERTHA	65	Hurricane Cat 1
1996	7	13	BERTHA	60	Tropical Storm
1997	7	24	DANNY	40	Tropical Storm
1999	9	16	FLOYD	70	Hurricane Cat 1
2000	9	23	HELENE	35	Tropical Storm
2000	9	24	HELENE	40	Tropical Storm
2004	8	14	CHARLEY	60	Tropical Storm
2004	8	31	GASTON	35	Tropical Storm

Source: NOAA CSC Hurricane Mapping Tool

Figure 3: Storms within 100 nm of Gloucester County between 1980 and 2007



Source: NOAA CSC Hurricane Mapping Tool

Note: Category 1-2 Hurricane (shown in Red Lines), Tropical Storm (shown in Yellow Lines, Green Lines, and Black Thatched Lines)

Table 3: Storms within 100 nm of Gloucester County between 1980 and 2007

YEAR	MONTH	DAY	STORM NAME	WIND SPEED(KTS)	CATEGORY
1981	7	1	BRET	50	TropicalStorm
1983	9	30	DEAN	55	TropicalStorm
1983	9	30	DEAN	55	TropicalStorm
1983	9	30	DEAN	40	TropicalStorm
1985	9	27	GLORIA	90	Hurricane Cat 2
1986	8	17	CHARLEY	65	Hurricane Cat 1
1986	8	18	CHARLEY	70	Hurricane Cat 1
1986	8	18	CHARLEY	65	Hurricane Cat 1
1992	9	25	DANIELLE	55	TropicalStorm
1992	9	25	DANIELLE	55	TropicalStorm
1992	9	26	DANIELLE	40	TropicalStorm
1996	7	13	BERTHA	65	Hurricane Cat 1
1996	7	13	BERTHA	60	TropicalStorm
1996	7	13	BERTHA	60	TropicalStorm
1997	7	24	DANNY	40	TropicalStorm
1998	8	27	BONNIE	60	TropicalStorm
1998	8	28	BONNIE	65	Hurricane Cat 1
1999	9	16	FLOYD	90	Hurricane Cat 2
1999	9	16	FLOYD	70	Hurricane Cat 1
1999	9	16	FLOYD	60	TropicalStorm
2000	9	23	HELENE	35	TropicalStorm
2000	9	24	HELENE	40	TropicalStorm
2003	9	18	ISABEL	85	Hurricane Cat 2
2003	9	19	ISABEL	65	Hurricane Cat 1
2004	8	14	CHARLEY	60	TropicalStorm
2004	8	31	GASTON	35	Tropical Storm

Source: NOAA CSC Hurricane Mapping Tool

Nor'easters

Another type of major storm event that causes severe damage to the county is the nor'easter (Figure 4), also known as a "White Hurricane". This type of storm originates with little or no warning and is found along the middle and northern Atlantic coast. Flooding from a nor'easter tends to be caused by wave action combined with wind and restricted to the coastal zone. These storms are most frequent in the winter months, but can occur at any time of the year. They are most prevalent in Virginia between September and April (Middle Peninsula Planning District Commission, 2005).

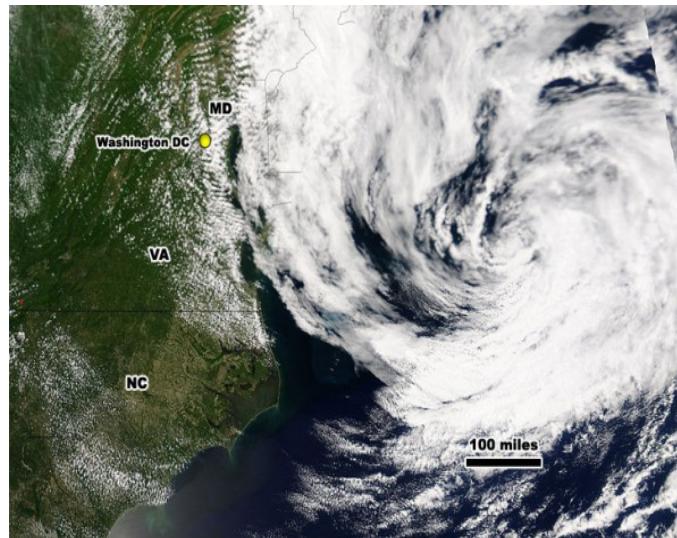
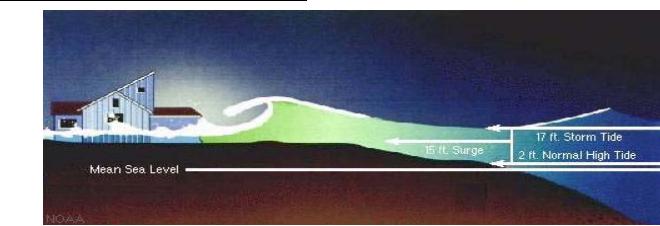


Figure 4: A nor'easter off the United States Eastern Coast.
Source: NASA/Goddard Space Flight Center

2.2 Storm Surge

As hurricanes and tropical storms pass over or near the coast atmospheric pressure drops, causing a large volume of sea water to build up, eventually being pushed ashore by the storm's winds causing a storm surge (Figure 5). The wind is an over-riding factor in storm surge. In the case of Gloucester County, strong East and Northeastern winds can push water from the Chesapeake Bay into the mouth of the York and Rappahannock Rivers and Mobjack Bay, flooding much of the county's low-lying areas (Middle Peninsula Planning District Commission, 2005). The total storm surge height depends on the storm's intensity and proximity to the county, and fluctuation in astrological tides.

Figure 5: Illustration of a Storm Surge



Source: NOAA NWS

When a hurricane or tropical storm makes landfall at high tide, the storm surge and the added water from the tidal fluctuation combine to create a "storm tide". In Gloucester County, tidal waters normally fluctuate twice daily from 1.2 feet above mean sea level to 1.2 feet below mean sea level (FEMA 1987, 6). If a severe hurricane were to make landfall during high tide, an additional 1.2 feet of water would be added to the highest storm surge possible, which could create a storm tide of 16.2 feet (Rygel, 2005).

Nor'easters, like hurricanes and tropical storms, can dump heavy amounts of rain and produce hurricane-force winds that push large amounts of sea water inland. However, this is not a true storm surge because a nor'easter does not cause an extreme drop in atmospheric pressure like that of a hurricane or tropical storm. Low atmospheric pressure

and high winds are responsible for the ocean water's ability to build up and eventually be pushed ashore; however, unlike a hurricane or tropical storm that makes landfall and slowly loses strength, a nor'easter can linger off-shore, often for many days, racking the coastline with powerful winds, strong waves, and large amounts precipitation (ice and rain). Flooding caused by a nor'easter is unlike flooding caused by a hurricane or tropical storm, because it can last for many days through many tidal cycles with the most severe flooding taking place during high tide. Flooding from a hurricane or tropical storm, on the other hand, is of shorter duration, rarely lasting more than one tidal cycle. In the event of a nor'easter, there could be multiple high tide levels being added to the storm surge level. For instance, if the storm lasted through three tidal cycles the storm tide could be as high as 18.6 feet (Rygel, 2005).

If a severe hurricane or nor'easter comes within 65 nm of the county, the event would be classified as a direct hit and deemed a natural disaster. This plan is not a disaster mitigation plan aimed to protect residents from the effects from severe hurricanes or nor'easters. Gloucester County's Emergency Operations Plan and Hurricane Response Plan aim to provide an effective and organized response from the local government in the event of a disaster of such caliber.

2.3 History of Hurricane Events in the Area

The August 1933 hurricane was born off the Cape Verde Islands and reached Category 4 strength, but weakened to a Category 2 before making landfall in Nags Head, North Carolina. The storm surge caused by the hurricane caused 18 deaths and \$79 million in damages in Virginia. The entire Tidewater area was paralyzed by the storm through loss of communication, electricity, water service and road access (Virginia Department of Emergency Management). According to a 1987 report written by FEMA this hurricane was the worst ever recorded along the Middle Atlantic coast:

“Norfolk reported the greatest 24-hr rainfall in its history, a fall of 6.64 inches. In Gloucester County, widespread damage to homes, cropland, and livestock resulted from the tidal flooding that reached an elevation of approximately 8.8 feet at Gloucester Point. Wells were fouled by the salt water, and the soil saturated by the salt intrusion required several years to return to its former productive state”

(FEMA 1987, 5-8).

The September 18, 1936 hurricane reached Category 3 and came within 25 miles of Virginia Beach, causing \$500,000 in damages to homes in the vicinity (Virginia Department of Emergency Management). The storm is documented in FEMA's Flood Insurance Study of Gloucester:

“...gale force winds caused much damage throughout the lower Chesapeake bay areas... At Gloucester Point, the elevation of flooding reached 6.4 feet” (FEMA 1987, 5-8).

On October 14, 1954, Hurricane Hazel devastated Virginia with a toll of 13 deaths and state-wide damages estimated at \$15 million (Virginia Department of Emergency Management). The storm is documented in FEMA's Flood Insurance Study of Gloucester County:

“Hurricane Hazel caused moderately high tides. The tidal flooding during this hurricane caused considerable salt damage due to the dry antecedent soil conditions. There was also severe damage from the wind and salt spray”
(FEMA 1987, 5-8).

On August 12, 1955, Hurricane Connie made landfall near Cape Lookout, NC and caused 16 deaths and \$1 million in damages to Virginia Beach and various parts of the Tidewater waterfront (Virginia Department of Emergency Management). The storm is documented in FEMA’s Flood Insurance Study of Gloucester County:

“The surge occurred at the time of the astronomical low tide in this area, and the resultant tide was approximately 4.3 feet at Gloucester Point. The extremely heavy rainfall of approximately 9 inches in 24 hours with this hurricane added to the damage inflicted by the tidal flooding”
(FEMA 1987, 5-8).

“Disastrous flooding and high waves occurred all along the Atlantic Seaboard from New York to Florida. Great destruction was caused by high waves and breaks superimposed on high tides. The waves and breakers undermined and collapsed buildings; eroded the beaches, roads, and sand dunes; interrupted communication and power lines, and damaged agricultural lands... The elevation of flooding reached 5.8 feet at Gloucester Point”
(FEMA 1987, 5-8).

In more recent years, on July 13, 1996, Hurricane Bertha devastated the local population by making landfall near Cape Fear and passing over Suffolk and Newport News, Virginia. The storm injured nine people and caused several million dollars in damages (Virginia Department of Emergency Management).

September 16, 1999, Hurricane Floyd cost Virginia more than \$255 million in damage; fallen trees killed two people and closed nearly 300 roadways. Flooding alone caused \$30 – \$ 40 million worth of damage. Rainfall in some areas was 12 to 18 inches (Virginia Department of Emergency Management).

September 18, 2003, Hurricane Isabel made landfall near Ocracoke Island, North Carolina. Across Virginia, there was \$625 million worth of damage and 20 deaths caused by the storm (Virginia Department of Emergency Management). The hurricane created a tidal surge of 6.4 feet at Gloucester Point with wind gusts up to 85 miles per hour throughout Gloucester County (FEMA 2007, 1).

September 1, 2006, the remnants of Tropical Storm Ernesto generated strong winds, heavy rainfall, and storm surge. The storm brought 5 to 8 inches of rainfall and severe flooding to eastern Virginia. Communities adjacent to the York River and northward to the Rappahannock River received tides that were 4 to 5 feet above normal, combined with 6 to 8 foot high waves. Flooding and high winds caused the death of seven people and an estimated \$118 million in damages. Significant damage was sustained to homes,

piers, boats, and marinas across the area. Power outages were widespread across the area (Virginia Department of Emergency Management).

2.4 Climate Change and Sea Level Rise

It has been widely studied and debated that our planet's temperature is rising and that this change in temperature is contributing to higher sea levels through melting of the Arctic ice caps and glaciers. If the earth's temperature is rising, this will have an effect on ocean temperatures as well. An increase in ocean temperature will likely increase the frequency and severity of coastal storms. Combined these factors mean that even less-severe coastal storms may produce more damaging floods.

Scientists at the Virginia Institute of Marine Science (VIMS) compared the affects observed in the Hampton Roads area caused by the August 1933 hurricane and 2003's Hurricane Isabel, which was a category one storm when it hit Virginia. Despite being a categorically weaker storm, Isabel brought water levels that were comparable to those seen in the 1933 storm. Data shows that the monthly mean sea level during Isabel was approximately 1.4 feet higher than the mean sea level from seventy years prior (Pizer, 2009).

NOAA scientists have calculated that sea level in the region has risen an average of about four millimeters per year relative to the land since 1928. A recent report by the U.S. Climate Change Science Program, suggests an additional sea-level rise of more than three feet by 2100(Pizer, 2009).

The Middle Peninsula Planning District Commission (MPPDC) and VIMS are currently being funded by the Department of Environmental Quality's Coastal Zone Management Program to study and map the predicted sea level rise for the Middle Peninsula. These maps will be available in the Fall of 2009. When more data becomes available the County should evaluate the potential impact of climate change on the community, particularly with respect to its wetlands, and consider potential management options.

2.5 Riverine Flooding

Riverine flooding is defined as the overflow of rivers, streams, drains, and lakes due to excessive rainfall, rapid snow melt, rapid ice melt or a combination of all three. This type of flooding involves the partial or complete inundation of normally dry land areas. It differs from coastal flooding, which is caused by a combination of rain, storm surge and wave action that affects primarily coastal areas (Webster County, 2008).

Approximately 60% of Virginia's river flooding is the result of flash flooding from tropical systems passing over or near the state. Riverine flooding also occurs because of successive rainstorms. Rainfall from any one storm may not be enough to cause a problem, but with each successive storm's passage over the basin, rivers rise until eventually they overflow their banks. If this occurs in late winter or spring, melting of snow in the mountains can produce additional runoff that can compound flooding problems (Watson, 2005).

There are several types of Riverine flooding including headwater, backwater and interior drainage flooding. Headwater flooding results from significant rain events that occur at

the upper reaches of a watershed that then flow downstream within a short period of time. Backwater flooding results when the lower portion of a river or stream is blocked by debris or backed up due to a storm surge along the coast. Interior drainage flooding results when a dam gives way and the water being held in the impoundment is released all at once to the downstream receiving channel (Webster County, 2008).

Periodic flooding of lands adjacent to non-tidal rivers and streams is a natural and inevitable occurrence. When stream flow exceeds the capacity of a normal water course, some of the above-normal stream flow spills over into adjacent lands within the floodplain. Riverine flooding is a function of precipitation levels and water runoff volumes within the watershed the stream or river (NCDCCPS, 2007).

The major rivers that surround Gloucester County are tidal in nature and they serve as estuarine tributaries of the Chesapeake Bay. Flood hazards vary due to the river's location and the type of storm event taking place.

2.6 Dam Impoundments

All dams in Virginia are subject to the Virginia Dam Safety Act and Dam Safety Regulations unless specifically excluded. The Virginia Department of Conservation and Recreation (VDCR) – Division of Dam Safety is the state agency responsible for enforcing the Virginia Dam Safety Act and the Virginia Soil and Water Conservation Board's Virginia Impounding Structure Regulations and oversees the issuance of Operation and Maintenance Certificates for regulated dams.

In September 2008, Virginia's dam regulations were amended, these amendments aim to treat all dam owners similarly and fairly in accordance with the regulations, increase awareness of dams and their potential impacts within localities and their citizens as well as help to improve the administration of the program. Dams are classified with a hazard potential depending upon downstream losses anticipated in the event of a failure. The hazard potential is unrelated to the structural integrity of a dam but rather it is directly related to potential adverse downstream impacts should the dam fail.

The hazard potentials are classified in the following manner:

- High - dams that upon failure would cause probable loss of life or serious economic damage.
- Significant – dams that upon failure might cause loss of life or appreciable economic damage.
- Low – dams that upon failure would lead to no expected loss of life or significant economic damage. This classification includes dams that upon failure would cause damage only to property of the dam owner, identified as Low Hazard (Special Criteria), which has fewer requirements for regulatory compliance than Low Hazard dams.

Currently there are 11 dams listed in Virginia's inventory of dams within Gloucester County: table 4 lists each dam, their respective hazard potential class, height, as well as the river each is located on. Of these dams only one is ranked as High Hazard:

Beaverdam Reservoir Dam, which is owned, operated and maintained by Gloucester County. The other 10 dams are privately owned and maintained and have either a Hazard Potential Class of Low Hazard or Significant Hazard. These 10 dams are currently not regulated by the dam safety program. Because of the above mentioned high hazard dam, later sections of this plan will primarily focus applicable mitigation activities specifically to the Beaverdam Reservoir Dam. Figure 6 shows the Beaverdam Reservoir Dam Flood Inundation Map which was updated in 2009 and depicts the homes that may be inundated in the event of a Sunny Day Dam Failure (SDDF)¹ and a Probable Maximum Flood (PMF)². The map shows 117 addressed buildings potentially inundated in a SDDF and 288 addressed buildings potentially inundated in a PMF dam failure (Emergency Action Plan, 2009).

Table 4: Dams in Gloucester County

Name	Hazard Potential Class	Top Height	River
Woodberry Farm Dam	Low Hazard	8	Jones Creek
Weaver Dam	Low Hazard	6	Jones Creek
Haynes Dam	Low Hazard	15	Carter Creek
Robins Dam	Significant Hazard	16	Wilson Creek
Cow Creek Dam	Significant Hazard	16	Cow Creek
Burke Dam	Significant Hazard	20	Burke Mill Stream
Cypress Shore Dam	Low Hazard	15	Tr-Piankatank
Haines Pond Dam	Low Hazard	9	
Beaverdam Reservoir Dam	High Hazard	39	Beaverdam Creek
Wood Duck Pond Dam	Low Hazard		
Leigh Lake Dam		12	

Source: VDCR April 4, 2009

There is no established database in Virginia of historic dam failures. Most dam failures occur due to a lack of maintenance of the dam facilities in combination with excessive precipitation events, such as seasonal coastal storms or thunderstorms.

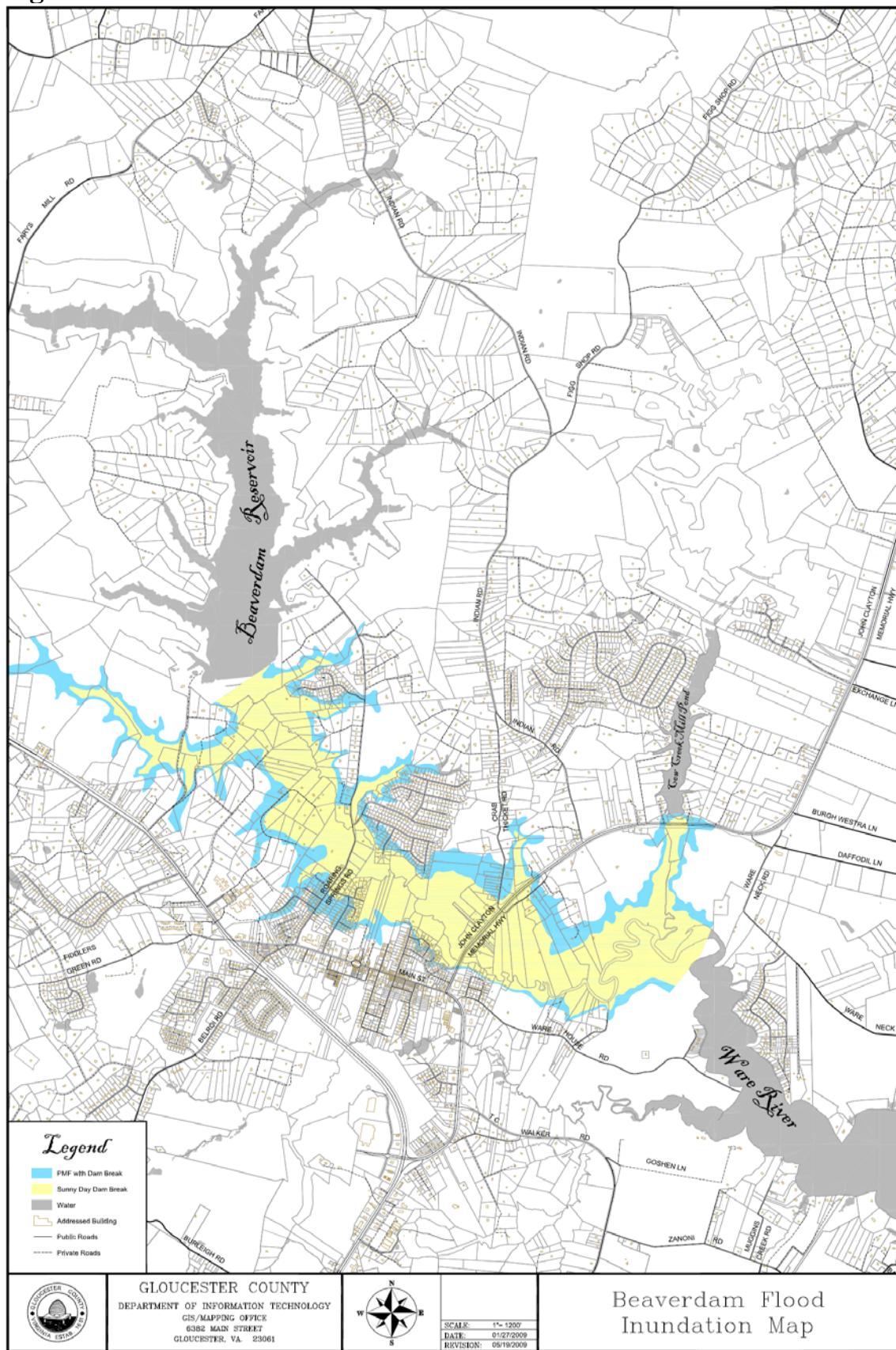
Dam failures pose risks when there are large populations located downstream from the dams. On-going dam inspections and Virginia's participation in the National Dam Safety Program maintained by FEMA and the U.S. Army Corps of Engineers serve as preventative measures against dam failures.

Failure of dams may result in localized major impact. Impact includes loss of human life, economic loss, lifeline disruption, and environmental impact such as destruction of habitat. Secondary impacts from dam failure include flooding of surrounding areas.

¹Sunny Day Damn Failure means the failure of an impounding structure with the initial water level at the normal reservoir level, usually at the lowest un-gated principal spillway elevation or the typical operating water level.

² Probable Maximum Flood means a flood that might be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Figure 6



Source: County Base GIS layers were provided by United States Census Bureau, the Built Structure layer (April 2009) was provided by Gloucester County DIT, and the Inundation Area layer was provided by Wiley & Wilson 2008.

3. Assess the Problem: Vulnerability of the Community

3.1 Property Damage

Elevation Profile of Gloucester County

Along its western and northwestern boundaries, Gloucester County has a maximum elevation of 160 feet above sea level, while most of the eastern and southeastern lands range from zero to five feet above mean sea level (Figure 8). For the southern portions of the county, Route 17 can easily be used as an elevation marker due to its bisecting qualities: it separates the majority of the low lying land on the southeastern portion of the county from the higher elevated portions of land on the southwestern portions of the county. The southern portion of Route 17 is constructed on land that is 20 to 40 feet above sea level. This is significant because elevation drops dramatically as one travels towards the eastern shore. The rapid elevation change is associated with a much larger bowl-shaped depression, known to scientists as the Chesapeake Bay Impact Crater (Powars 2000, 7).

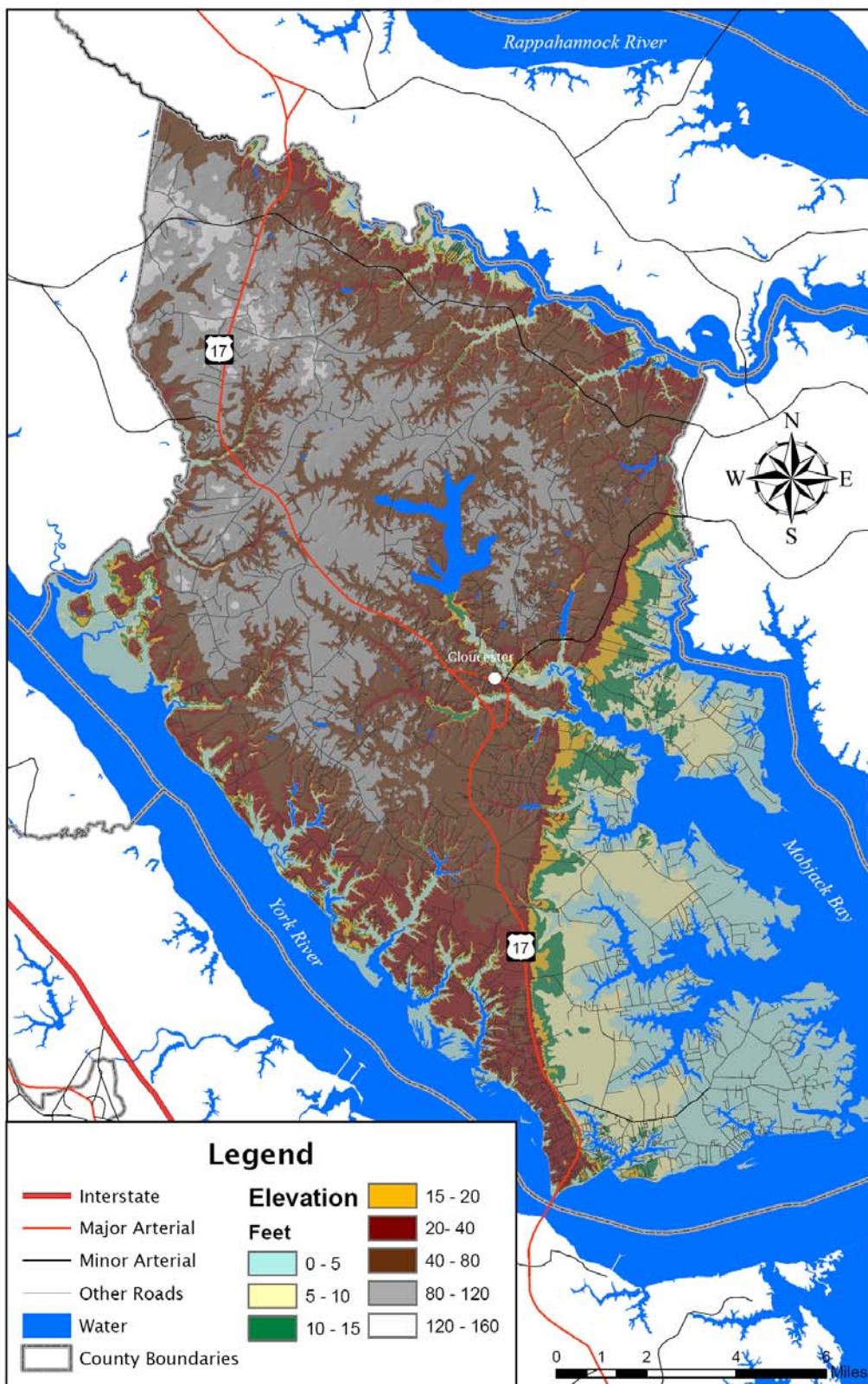
In the East and Southeastern portions of the county the land is mainly flat and characterized by marshland and shoreline. This land is the most vulnerable to coastal flooding because there is little, if any, difference in elevation and not much in the way of vegetation that serve as a barrier to storm surge (Figure 7).



Figure 7: Typical landscape of SE Gloucester County.

Figure 8

Gloucester County Elevation Profile



Source: County Base GIS layers were provided by United States Census Bureau and the Elevation GIS layers were provided by USGS.

Special Flood Hazard Area

FEMA investigated the flood hazards in Gloucester County from 1983 to 1987. This investigation yielded the county's FIS and FIRM, both of which are used to develop flood risk data for the community and establish flood insurance rates throughout the region. The FIRM depicts flooding during a 100-year storm event (storms that have a 1% chance of being equaled or exceeded in any given year). The FIRM accounts for both storm surge driven flooding, as well as flooding caused by heavy rainfall. The map provides base flood elevations for the entire county derived from detailed hydraulic analysis of the area described in the FIS. The map also provides flood zone designations for the entire county describing the type of flooding experienced.

In 2003, Gloucester County's FIRM was converted to digital form (known as Q3 data). The Q3 data is not as detailed as the hard copy FIRM; it contains the 100-year and the 500-year floodplain boundaries (including velocity zones), and flood insurance zone designations but lacks base flood elevations. For purposes of this plan, the county's Q3 data is a sufficient tool to help assess vulnerability of the community's roads and built structures in the special flood hazard area (SFHA), (Figure 9).

FEMA is in the process of updating the FIRM for all localities in the country. Gloucester County's updated FIRM is estimated to be available sometime in October or November of 2009. Once updated the new FIRM layer can be integrated into the County's Geographic Information System (GIS), however until then; the 2003 Q3 data will be used. Below are the flood zone descriptions the Q3 data references:

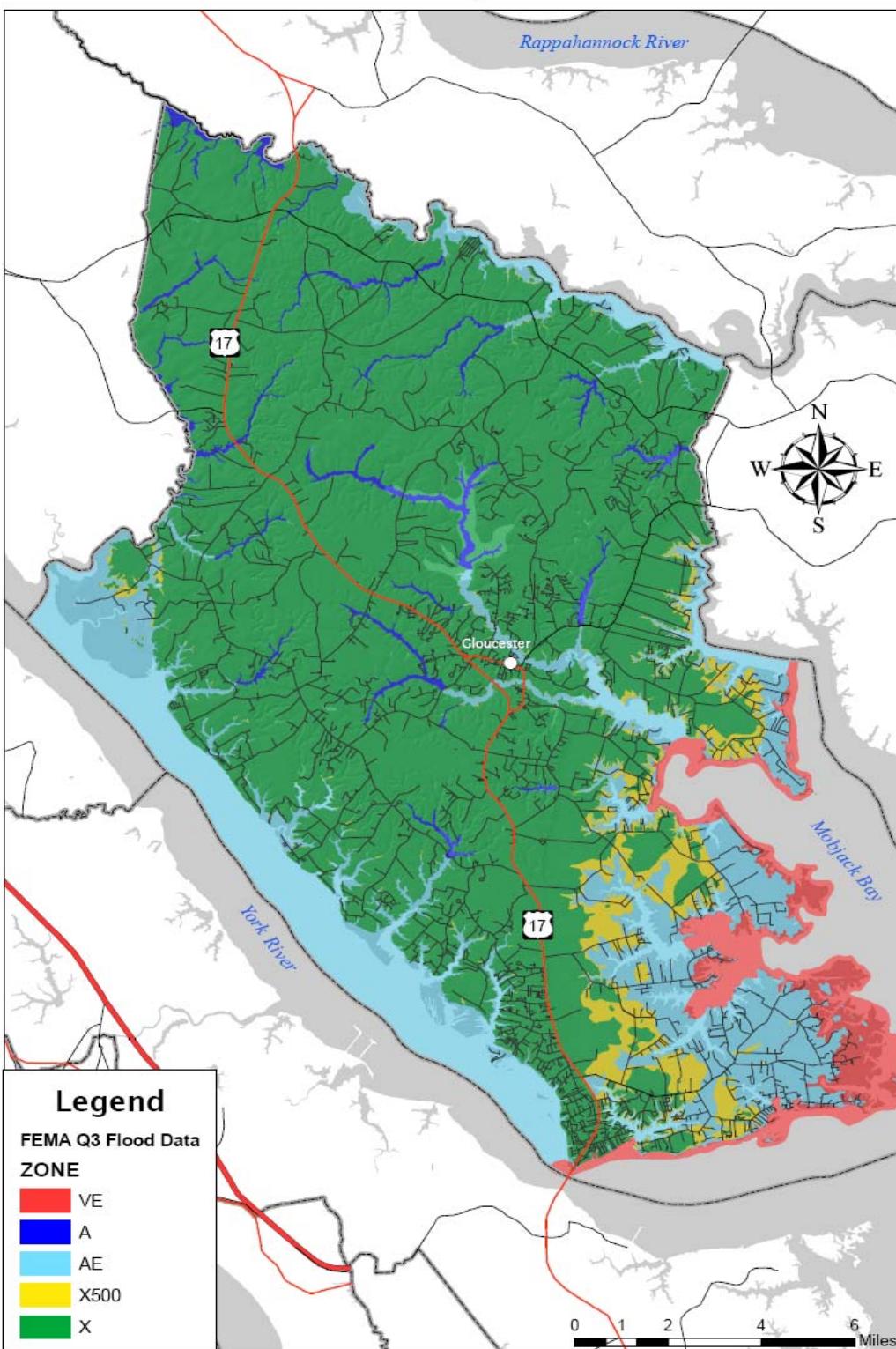
- Zone VE and V - SFHA along the coast, inundated by the 100 year flood with high velocity hazard caused by wave action. Purchase of flood insurance is mandatory.
- Zone A - SFHA inundated by the 100 year flood. Purchase of flood insurance is mandatory.
- Zone AE – SFHA inundated by the 100 year flood. Purchase of flood insurance is mandatory.
- Zone X and X500 – areas are outside of the 100 year floodplain, not classified as SFHA.

The updated FIRM will utilize a new SFHA classification to describe the type of flooding described below:

- Zone LiMWA - Limit of Moderate Wave Action Zone, wave action associated with the VE Zone does not automatically cease at the delineation of the AE Zone. To address this issue the AE Zone category has been divided by FEMA into a Limit of Moderate Wave Action (LiMWA) zone. The LiMWA represents the approximate limit of the 1.5 foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA will be similar to, but less severe than those in the VE Zone.

Figure 9

Gloucester County Flood Districts



Source: County Base GIS layers were provided by United States Census Bureau and the Q3 GIS layers were provided by Mindsites Group, LLC. (This figure is not 100% accurate in that it does not show the Beaverdam Reservoirs' flood zones).

Addressed Structures in the Special Flood Hazard Area

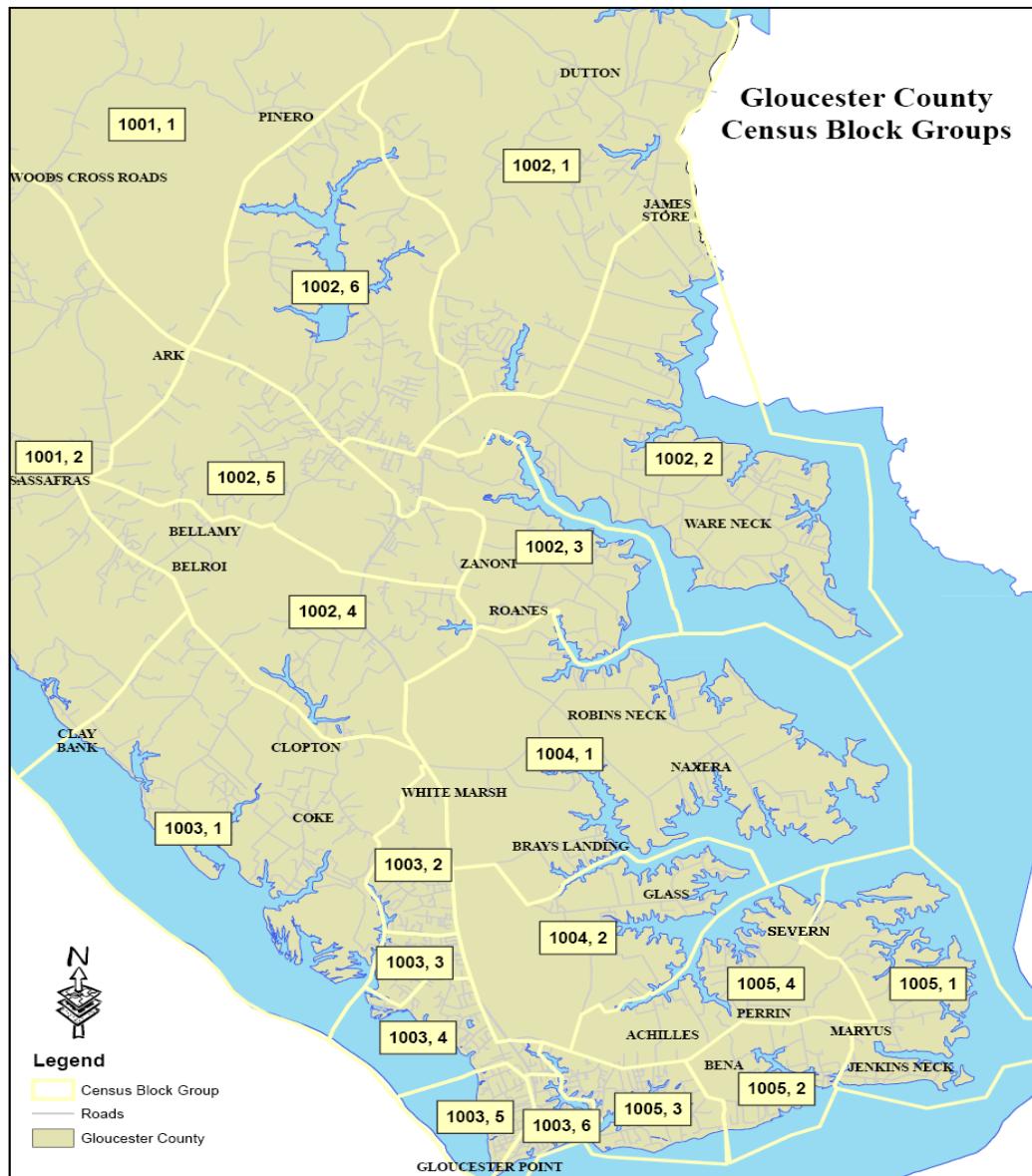
In 2005, a study conducted by the Middle Peninsula Planning District Commission (MPPDC) listed the number of addressed structures in Gloucester that are located in each special flood hazard area (VE, AE, A). The total number of addressed structures in the SFHA at that time was 2,233. Of these 1,062 or 48% are located in Census Tract 1005, Block Group 1, 2, 3 and 4 (Figure 10), which is comprised of what is locally known as Jenkins Neck, Maryus, Severn, Achilles, Bena, Perrin, and portions of Gloucester Point (southeastern portion of Gloucester County). Another 453 or 20% are located in Census Tract 1004, Block Group 1 (locally known as Robins Neck and White Marsh) and Block Group 2 (locally known as Glass). Another 301 or 13% are located in Census Tract 1002, Block Group 1 (locally known as Dutton) and Block Group 2 (locally known as Ware Neck), (Middle Peninsula Planning District Commission, 2005). Figure 10 shows the location of each of these areas with relation to Gloucester County. To view the entire study with relation to Gloucester, see Appendix B.

Pre-FIRM Structures in the Special Flood Hazard Area

The above referenced study conducted by the MPPDC also analyzed Gloucester County's addressed structures with relation to the year they were built. According to the study, 12,065 of the 15,260 structures (79%) in Gloucester County were built prior to 1989, before flood risks of the area were officially identified, and are classified as pre-FIRM structures (Middle Peninsula Planning District Commission, 2005). Most pre-FIRM structures were not built with flood-proof techniques and thus are more vulnerable to flooding.

Of the county's 12,065 pre-FIRM structures 1,950 or 6% are located in a Special Flood Hazard Area (VE, AE, A), and in 2005 had a total estimated value of \$214,482,700. Of these, 973 or 50% are located in Census Tract 1005, Block Groups 1, 2, 3 and 4 (Figure 10) which is made up of Jenkins Neck, Maryus, Severn, Achilles, Bena, Perrin, and portions of Gloucester Point (southeastern portion of Gloucester County). In 2005, the total estimated value of these area's pre-FIRM structures was \$98,658,900. Notably there are 388 or 20% of the total located in Robins Neck/ White Marsh and Glass. In 2005, the combined total estimated value of these area's pre-FIRM structures was \$45,215,800. Of the total, 253 or 13% are located in Dutton and Ware Neck. In 2005, the combined total estimated value of these area's pre-FIRM structures was \$34,426,800 (Middle Peninsula Planning District Commission, 2005). Figure 10 shows the location of each of these areas with relation to Gloucester County. To view the entire study with relation to Gloucester, see Appendix B.

Figure 10: Gloucester County Census Block Groups



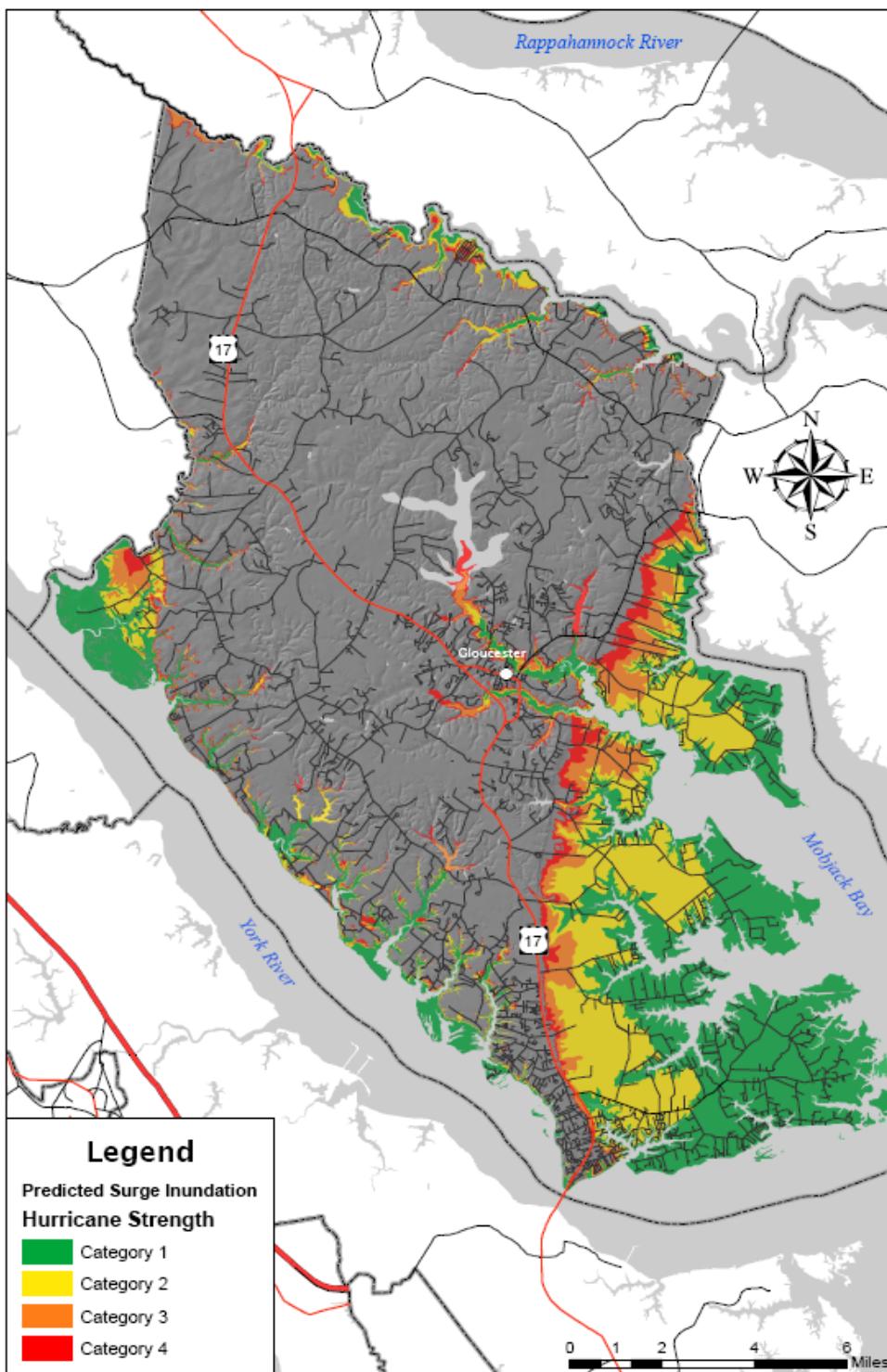
Source: Gloucester County Information Technology/ GIS Department.

Storm Surge Map

Another tool to determine the vulnerable areas of a community is the storm surge map. A storm surge map reflects the worst case hurricane storm surge inundation (at astronomical high tide) from a direct hit from the hurricane as it makes landfall. These maps do not show areas that may be flooded by excessive rainfall; they only depict flooding as a result of storm surge (Hampton Roads Emergency Management Committee, 2006). Also, these maps do not indicate depth of flooding (Gloucester County, 2006). Gloucester County's surge map (Figure 11) illustrates possible storm surge inundation areas in the county. In every storm surge scenario the eastern and southeastern portion of Gloucester County experience the highest risk of storm surge flooding. As the intensity of the hurricane grows, areas further inland are at higher risk of flooding from storm surge. Due to the rapid increase in the county's elevation levels as one travels inland, the intrusion of storm surge caused by increasing storm strength does not change dramatically, i.e. the area impacted by the storm surge from a Category 3 or 4 hurricane is not much greater than from a Category 2 hurricane (Figure 8).

Figure 11

Gloucester County Storm Surge



Source: County Base GIS layers were provided by United States Census Bureau and the Storm Surge GIS layers were provided by Gloucester County Information Technology/ GIS Department. (This figure is not 100% accurate due to the storm surge being shown extending passed Beaverdam Reservoir Dam, the elevation of the toe of the dam was increased during the dams original construction and has eliminates this from occurring).

Potential Structural Vulnerability to Storm Surge Inundation

The 2005 study conducted by the MPPDC also analyzed Gloucester County's potential structural vulnerability to storm surge inundation caused by Category 2, 3, and 4 hurricanes.³ Throughout Gloucester County, nearly 23% of all addressed structures (3,443 total) lie within the predicted storm surge for a Category 2 hurricane. A storm surge from a Category 3 hurricane had the potential to affect 26% of the county's addressed structures (3,994 total), and in 2005 had the potential for \$459 million in damages. A storm surge from a Category 4 hurricane had the potential to affect 600 additional structures, and in 2005 it was estimated to cause over \$527 million in property loss (Middle Peninsula Planning District Commission, 2005).

The MPPDC's study determined that the census block groups with the most potential to be severely affected by storm surges are in Census Tract 1005, Block Group 1, 2, 3 and 4 (Figure 10) which is comprised of Jenkins Neck, Maryus, Severn, Achilles, Bena, Perrin, and portions of Gloucester Point (southeastern portion of Gloucester County). Every built structure within these four census block groups lies within the predicted storm surge from a Category 2 hurricane - a total of 1,798 structures; in 2005 it was estimated at \$196,380,100 in potential property losses.

Other census block groups with high potential to be severely affected by storm surge are in Census Tract 1004, Block Group 1 locally known as Robins Neck and White Marsh and Block Group 2 locally known as Glass (Figure 10). In Block Group 1, 80% of the built structures run the risk of inundation by a storm surge from a Category 2 hurricane - a total of 377 structures, in 2005 it was estimated at \$46,898,800 in potential property losses. In Block Group 2, 68% run the risk of inundation by the same surge, a total of 265 structures; in 2005 it was estimated at \$29,097,000 in potential property losses.

Another census block group with high potential to be severely affected by storm surge is in Census Tract 1002, Block Group 2 locally known as Ware Neck (Figure 10). A little over 55% of the block group's built structures run the risk of inundation by a storm surge from a Category 2 hurricane – a total of 339 structures, in 2005 it was estimated at \$48,205,800 in potential property losses (Middle Peninsula Planning District Commission, 2005).

Repetitive Loss Areas

FEMA classifies Repetitive Loss Properties as those that have made flood damage claims of \$1,000 or more twice within a 10-year period. FEMA classifies Severe Repetitive Loss Properties as any property that has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000. The properties on the list are subject to change over time, and will depend on the frequency and severity of the seasonal coastal storms that affect the area. As of June 30, 2008, there were 65 repetitive loss and 1 severe repetitive loss properties in Gloucester. Of the 65 repetitive loss properties 59 are residential and

³ (Note: Category 1 and Category 5 hurricane surge data is not analyzed in the structural vulnerability study due to data limitations.) (For study see Appendix B).

the other 6 are businesses. The county's only severe repetitive loss property is a residence. Gloucester is classified as a "Category C" repetitive loss community (> 10 repetitive loss sites) and must tailor its floodplain management plan specifically to the county's repetitive loss areas.

Due to Privacy Act requirements, Repetitive Loss & Severe Repetitive Loss properties will be generalized based on location, and will further be known as a Repetitive Loss Areas. These areas and the amount of repetitive loss properties in them will aid in the county's determination of which portions of the county have the most frequent and severe flood related damages to residences, and will be high priority target areas for future mitigation activities. The majority of the county's repetitive loss properties are located in the southeastern portion of the county, with a high concentration being located in Jenkins Neck, Maryus, Severn, Achilles, Bena, Perrin, and portions of Gloucester Point as well as in Glass. There are also four additional repetitive loss properties located in Ware Neck, two located in both Roanes and Coke, and one located in Dutton (Table 5 and Figure 10).

Table 5: Repetitive Loss Areas

Repetitive Loss Areas	Area of the County	Number of Properties
Jenkins Neck	Southeastern	16
Glass	Southeastern	12
Achilles	Southeastern	11
Severn	Southeastern	7
Maryus	Southeastern	6
Bena	Southeastern	2
Perrin	Southeastern	2
Coke	Southwestern	2
Ware Neck	Central Portion	4
Roanes	Central Portion	2
White Marsh	Central Portion	1
Dutton	Northeastern	1

Source: FEMA, 2008

As of June 30, 2008 Gloucester County's 66 repetitive loss properties have received a combined \$4,183,622 in flood insurance damage claims within the last ten years (FEMA, 2008). Of these repetitive loss properties 24 have been mitigated against damages caused by flooding through either elevation or demolition of the primary structure, or acquisition of the property itself. Regardless, these properties remain on the list due to the required time frame that must pass since each repetitive loss property last had an insurance claim. Throughout this plan, once a property has received flood mitigation it will no longer be considered as a primary target area for future mitigation strategies. Later sections of this plan will focus applicable mitigation activities specifically to the properties or areas that have not received mitigation against damages caused by flooding.

Highest Priority Target Areas Based on Vulnerability

Areas in the county that are the most vulnerable to flooding will be considered the target areas for future flood mitigation activities, and classified as such. Rather than utilize repetitive loss properties as the sole indicator of an area's vulnerability, a combination of four indicators will be utilized: 1) highest concentration of addressed structures in the SFHA 2) highest concentration of pre-FIRM structures in the SFHA 3) highest percentage of structural vulnerability to storm surge inundation and 4) highest amounts of repetitive loss properties. Utilizing a combination of these four indicators will help justify areas in the county that may not have been affected by a seasonal coastal storm in recent history but have high potential for catastrophic results in the event of a seasonal storm. This decision is based on the very nature of seasonal coastal storms, which are characterized by their unpredictability with regard to frequency, duration, strength and trajectory. The amount of repetitive loss properties in an area can dramatically change from coastal storm event to coastal storm event. If the county were to utilize repetitive loss properties as the sole indicator of vulnerability it would be placing too much emphasis on past storms rather than preventing future damages from future coastal storms.

Based on this plans' analysis of the 2005 study conducted by the Middle Peninsula Planning District Commission, (which was discussed in the previous four sections) the area of the county that is most vulnerable to flooding is the southeastern portion of the county, which includes the most addressed structures in the SFHA, possesses the most pre-FIRM housing in the SFHA, and has the highest percent of structures predicted to be inundated in a storm surge, as well as has the highest number of repetitive loss properties in the county. Because of these findings the Jenkins Neck, Maryus, Severn, Achilles, Bena, Perrin, and portions of Gloucester Point (southeastern portion of the county) are considered the highest priority target area for future flood mitigation strategies in the county.

Other target areas in the county are Robins Neck and White Marsh, Glass, Dutton, and Ware Neck.

3.2 Vulnerable Populations

In Gloucester County, 3,884 residents (11%) are living in the county's most severe coastal flood hazard area, Census Tract 1005 (southeastern portion of the county). In order to maximize the effectiveness of this plan, it is imperative to identify vulnerable segments of the population at risk of coastal flooding hazards. By understanding the population at risk, emergency management planners will be better equipped to review the effectiveness of the existing flood mitigation practices and address the unmet needs of the area. To assess the social vulnerability of the high hazard area, age, disability, and income levels were identified from the 2000 Census and analyzed at the Census Tract level.

Age and Disability

According to the 2000 Census, Census Tract 1005 is largely made up of middle-aged residents (median: 42 yrs); 23% of the population is under the age of 18, a quarter of

which are children above five years old. The southeastern portion of the county also has a moderate number of elderly (15% 65 or older). Recent population projections by age cohort for the county show large increases in the elderly population in coming decades with 22% of the county being elderly by 2020, and almost 37% by 2030.

The area's disabled population includes a wide range of age groups. According to the 2000 Census, 32% of all residents in this Census Tract who are above five years of age are living with a disability, and 30% of the disabled are 65 years of age and older.

Young children, the elderly, and the disabled populations are important to consider due to their lesser capacity to protect themselves in hazardous situations, and their limited levels of mobility (Sorenson, 2006).

Income

According to the 2000 census, annual income levels in Census Tract 1005 are very evenly distributed: 27% <\$24,999, 27% \$25,000 - \$49,000, 19% \$50,000 - \$74,999, and 27% >\$75,000.

Typically, low income households face higher levels of risk from flooding because they can least afford the costs associated with relocation, property protection (e.g. elevating structure), repair and cleanup (e.g. tree removal, floor replacement, and appliance replacement) (Sorenson, 2006).

3.3 Critical Facilities

Critical facilities are those that are crucial to the every-day functioning of a community, or that provide essential services during emergencies and are charged with providing special care to vulnerable populations. The vulnerability of critical facilities can be assessed by their location in a flood zone as depicted in the digitized FIRM, as well their location in an area potentially inundated by storm surge from a hurricane (Figure 12) (NOAA CSC Risk and Vulnerability Assessment Tool).

Fire and Rescue

Gloucester has six fire and rescue stations throughout the county (Appendix I). The Gloucester Volunteer Fire and Rescue Department maintains three stations that serve the northern portion of the county (Stations 1, 4 and 6). Abingdon Volunteer Fire Rescue maintains three stations that serve the southern portion of the county (Stations 2, 3 and 5). None of Gloucester's six fire and rescue stations are located in a flood zone; however, Station 2 (located in the southeastern portion of the county) could be inundated during a storm surge from a Category 2 hurricane (Figure 12). Previous coastal flooding caused by documented hurricane induced storm surges has not hindered the stations ability to respond. No other fire and rescue station in Gloucester is located in an area potentially inundated by storm surge.

Shelters

Gloucester utilizes several public schools as shelters during emergency events. Only one of the nine public schools in Gloucester County - Achilles Elementary School (located in

the southeastern portion of the county) - is within a flood zone, classified AE (area inundated by the 100 year flood). This school is also located within the predicted extent of storm surge flooding caused by a Category 1 hurricane (Figure 12); however, according to the Gloucester County Emergency Operation Plan (EOP), Achilles Elementary School is not used as a shelter during seasonal storms because of its vulnerability to flooding (Gloucester County, 2002).

Public Water (Beaverdam Reservoir)

Gloucester County provides various public services and facilities for its residents, including those related to water supply and sewage disposal. The Beaverdam Reservoir and its associated water treatment plant provide portions of the county with public water. The facility is located just north of the courthouse area and is contained by an earthen dam. The reservoir covers approximately 655 acres, and is surrounded by a 300 to 600 foot buffer of county owned forestland that makes up the Beaverdam Reservoir Park (Middle Peninsula Planning District Commission, 2005). The impounding structure for Beaverdam Reservoir, Beaverdam Reservoir Dam, is classified as a “High” hazard dam.

Dams are classified with a hazard potential depending upon downstream losses anticipated in the event of a failure as opposed to their structural integrity.

The dam was constructed in accordance with plans approved by the Virginia Department of Conservation and Recreation (VDCR). In addition, VDCR has issued the required operational certificates directing/confirming the safe operation of this facility. There have never been any flooding problems related to the dam structure serving the reservoir. Portions of the reservoir are located in flood zones AE and A, and according to county storm surge maps the downstream side of the dam itself has the potential to be inundated by a storm surge from a Category 3 hurricane. However, this does not pose any significant risk to the dam given it is designed to pass the probable maximum flood (PMF) which vastly exceeds a 100 year flooding event. The dam’s emergency spillway was tested during 1999’s Hurricane Floyd and behaved as designed with water flowing downstream using the primary and emergency spillways.

Private Water

Where public water is not available or citizens chose not to use available public water, Gloucester County citizens use thousands of private deep and shallow wells (Gloucester County, 2002). Depending on the location of an individual household, the well system may be in a flood zone or in an area potentially inundated during a storm surge. These private water supplies are susceptible to contamination during flooding (see “Safety and Health Hazards” below) and usually are a key factor for attention in post disaster remediation.

Public Sewer and Private Sewage Disposal

Portions of Gloucester County are served by public sewer. The county’s sewage is collected and pumped by pump stations that are owned by the county. The sewage is then transported through underground pipes that are owned by the Hampton Roads Sanitation District, these lead from the courthouse area along Route 17, under the York River and to Hampton Roads. The system is a closed underground system (force main) that does not sustain damages during severe flooding events. However, there were two

pump stations in the Gloucester Courthouse area (Pump #11 and Pump #13) that sustained damage during Hurricane Floyd in 1999. According to the Department of Information Technology and the Public Utilities Department there are approximately 282 lots within 200' of the Sewer lines along Guinea Road (in the county new residences within 200' of the sewer and water lines must connect, after the 200' connection is optional if the service is available). Of these 282 lots, 167 are currently connected to water, sewer or both. Of the 282 lots, 33 lots have a meter and choose to pay a flat fee rather than connect. The other 82 properties are vacant and must connect if they are to be developed. Of these the majority are in a flood zone.

Others portions of the county utilize septic tanks for private sewage treatment. Depending on the location of an individual household, the septic tank may be in a flood zone or in an area potentially inundated during a storm surge.

According to the Virginia Department of Health there are many residences that utilize either public sewer or private septic systems that also utilize public water. This may pose a special problem during storm events. In cases where the sewage system becomes disabled (either by disability of a mechanical appurtenance or through a power outage) and a water supply remains uncompromised, the result is usually a back-up of sewage into the structure or an exposure of sewage on the ground surface (as experienced after Hurricane Isabel) (see "Safety and Health Hazards" below).

Roads

Gloucester County residents primarily utilize Rt. 17 - George Washington Memorial Highway - as the main artery of the County. The four lane highway runs North-South through the center of the County. Unfortunately VDOT does not keep records of which roads flood and to what extent. In an effort to identify the roads that are most vulnerable to damage from coastal flooding, road closure data was obtained from VDOT and utilized in the plan. Rt. 17 has not been closed⁴ due to flooding in past storm events.

Regardless, two segments of the road are located in a flood zone, classified AE (area inundated by the 100 year flood), and are potentially affected by storm surge. The first is near the court house area of the County and would be potentially inundated by a storm surge from a Category 1 hurricane. The second is located at the southern end of the County and has potential to be inundated by a storm surge from a Category 3 or 4 hurricane (Figure 12). Box culverts were utilized during the design and construction of the road to divert water under the roadway, these culverts are capable of flowing large amounts of water before flooding the road above.

Notably, the majority of roads in the southeastern portion of the county are built in a flood zone, (classified as VE and AE), and would be inundated during a Category 1 hurricane. And all the roads in this area of the county would be potentially inundated in a Category 2 hurricane (Figure 12). Over a seven year time frame (1999 – 2006) which included 1999's Hurricane Floyd, 2003's Hurricane Isabel, and 2006's Hurricane Ernesto, there has only been one road in the southeastern portion of the county (on one occasion) that has been closed⁴ due to flooding - Rte. 649 (Maryus Road) from

⁴ The definition of a road closure by VDOT is when a road is closed due to damages to the road which make it impassable, such as a washout. Closures caused by downed trees were not considered in this list, nor was a temporary "closure" caused by standing water considered in the list.

Hurricane Ernesto in 2006. While there have been no other closures⁴ in this area of the county during the 7 year time frame, per VDOT recommendation Route 646 (Jenkins Neck Road) will be considered as a high risk road because it has flooding during every coastal storm event in recent years. In this plan the road closure data for the County will primarily focus on roads that have flooded on two or more occasions during the seven year period mentioned above (Table 6). The causes of the road flooding will be discussed in further detail in Chapter 5 in the Structural Improvement Activities section.

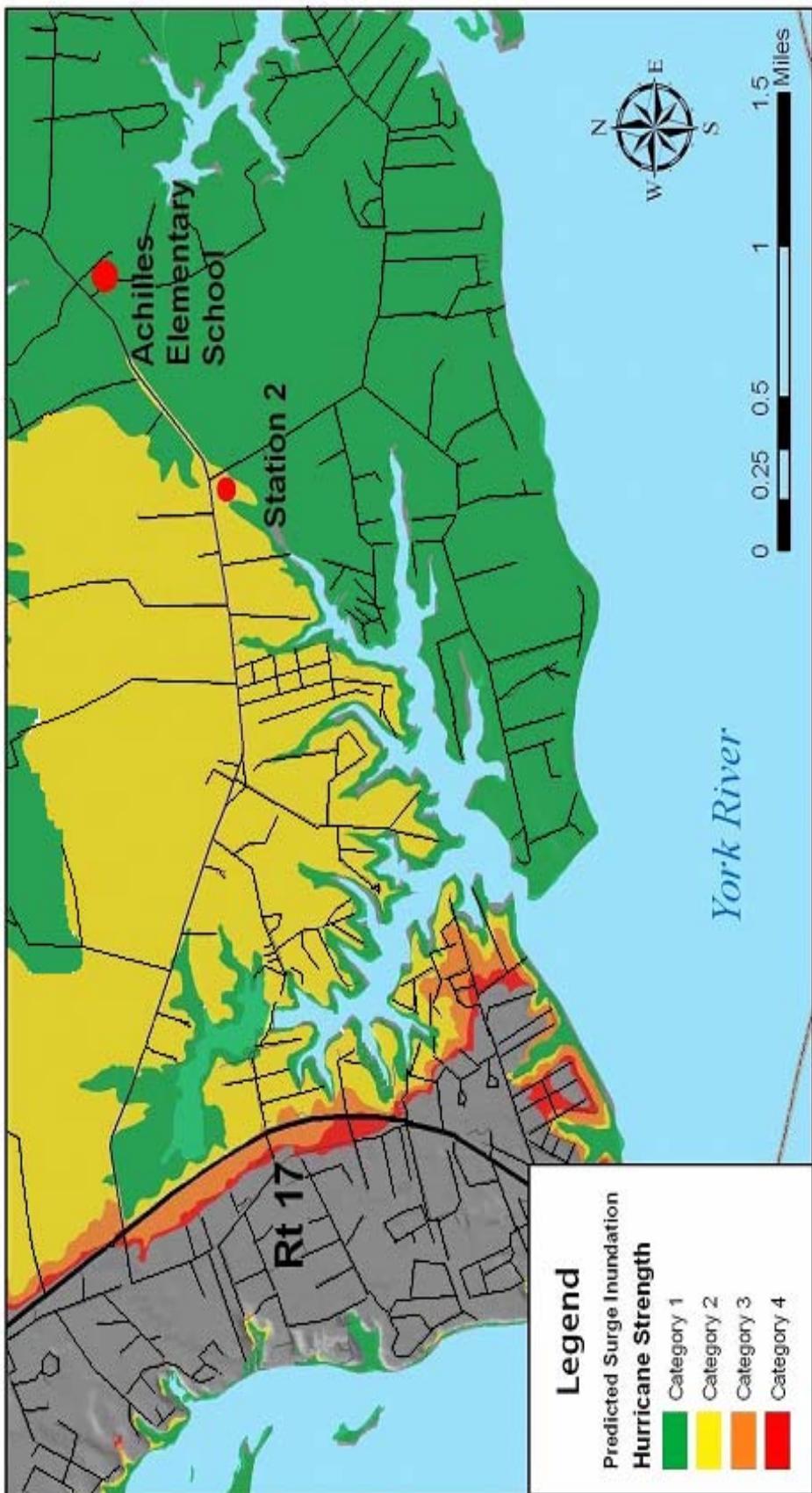
Table 6: Road Closures due to Flooding from 1999 - 2006

Rte.	Road Segment
605	Indian Road at Beaverdam Reservoir.
606	Farys Mill Road at Beaverdam Park second entrance.
610	Salem Church Road at the fourth bend.
614	Featherbed Lane at second bend.
614	Segment: Hickory Fork Road at Haynes Mill Pond. (<i>This road segment was fixed in 2006 and has not been closed since</i>).
625	Ditchley Drive nearest the North River.
662	Allmondsville Road at the bend.
1208	Greate Road at the boat landing.

Source: VDOT, 2007

Figure 12

Critical Facilities in the Southeastern Portion of Gloucester County



Source: County Base GIS layers were provided by United States Census Bureau, and the Storm Surge GIS layers were provided by Gloucester County Information Technology/ GIS Department.

3.4 Safety and Health Hazards

Flooding has the potential to cause a significant amount of safety and health hazards in the county. Nationally, the most deaths from flooding occur while attempting to evacuate the flood-prone area. Victims become trapped in their vehicles and drown while driving through floodwaters that appear shallow but turn out to be deep (Des Plaines Engineering Department 2002, 23). In Gloucester there have been very few deaths caused by flooding; one of the more recent occurred on September 18, 2003 (Hurricane Isabel) when an individual died of a heart attack after their vehicle became partially submerged and they attempted to push the vehicle to dry land, unsuccessful the driver returned to the vehicle and suffered a heart attack as the vehicle was being swept away in high waters. Other recent flood related deaths in the County have come about from trees falling on residential structures during or after a storm event (Middle Peninsula Planning District Commission, 2005).

While death is ultimately the worst hazard possible, there are other significant health and safety hazards that can result from flooding events, such as an abundance of solid waste and debris, the spread of disease by mosquitoes, fuel spills and chemical waste, exposure to raw sewage caused by septic tank failure, possible damage or destruction of private water supply, and exposure to mold spores. The possibility of flooding causing serious safety hazards are amplified when flooded areas become inaccessible to emergency responders (fire, rescue squad, and police personnel) by high water and or flood related road damage (Des Plaines Engineering Department 2002, 23). Gloucester County's road network has experienced damage caused by coastal flooding on numerous occasions (VDOT, 2007). These were briefly discussed in Section 3.3 Critical Facilities and will be discussed in further detail in Chapter 5 in the Structural Improvement Activities section.

Solid Waste and Debris

Hurricanes and associated storms typically generate large amounts of solid waste through wind damage and/or flooding. Solid wastes generated may include debris, demolition waste, spoiled food, household goods and products, and other municipal solid wastes. After a hurricane, solid waste management facilities typically experience significant increases in waste intake rates due to the cleanup efforts which may strain their normal capabilities. Nonetheless, they are still required to meet all regulatory and permit requirements, or obtain temporary modifications of their permits as approved by the Department of Environmental Quality (DEQ, 2009).

Originally adopted on June 29, 1998 and revised August 9, 2001 the Gloucester County Disaster Solid Waste Plan appropriately plans for an increased amount of solid waste generated by coastal storm events. In the plan it is estimated that a Category 4 hurricane could generate 126,000 cubic yards of waste materials in just seven square miles of the County's most densely populated areas. Because of this the Disaster Solid Waste Plan is an important part of the County's overall emergency preparedness planning. The plan sets forth relevant County policies and provides procedures to be followed when the plan is implemented.

For example; in the event of a major disaster, such as a federally declared disaster, but without waiting for such a declaration, the County may, in accordance with the plan, arrange for the activation of the temporary debris storage and reduction site at the VDOT

Park and Ride on Route 216. The County will make appropriate payments for the operation of this site. Individual residents, non-resident land owners, and businesses who transport their own material to the disposal site are acting as County agents in self-hauling debris, they shall sign a statement to the affect that they are giving the approximate load size along with their name, address, and telephone phone number when dropping the material. Any persons who are collecting brush or debris and transporting it for others for a fee are classes as "commercial haulers". All commercial haulers, whether working for a County citizen, County business, or the County itself shall deposit their material at the landfill only. The above procedure is just one of the many described in the plan, for all procedures see the Gloucester County Disaster Solid Waste Plan, 2001.

While the county has planned for the increased amounts of solid waste due to major storm events, residents can help reduce the amount of waste that goes into the landfill by recycling specific types of solid waste and debris. Debris (downed timber, logs, stumps and brush) can be sorted by size and processed for various reuse projects such as mulch or firewood. The remaining waste should be taken to the landfill or temporary debris storage facility for disposal.

Other Types of Debris

While the above mentioned reuse efforts can tremendously cut down on the amount of waste that goes into the landfill, there are other types of debris (treated wood, propane cylinders, demolition waste, asbestos containing waste, lead paint abatement waste, construction waste, household hazardous waste, and petroleum contaminated waste) that must be properly disposed of or reused due to the potential hazards to human health if ingested or inhaled (DEQ, 2009).

Spread of Disease by Mosquitoes

Large amounts of standing water brought about by excess rain and flooding from coastal storms creates unusually large amounts of additional habitat for mosquitoes to breed. Mosquitoes are known carriers for various types of bacteria and viruses to include among other things; West Nile Virus, Eastern Equine Encephalitis, Dengue Fever and Yellow Fever.

The mosquito problem is divided up into two distinct waves of activity that occur after a flooding event. The initial influx or first wave of mosquitoes belong to a group known as flood water mosquitoes which include the salt marsh and pastureland mosquitoes. These mosquito species deposit their eggs on soil and in depressions that are subject to periodic flooding. When flooded, the eggs hatch simultaneously resulting in large swarms of mosquitoes five to seven days after the flooding event during the warmest times of the year. These mosquitoes are primarily annoyance species that play minor roles in disease transmission.

After the initial wave of flood water mosquitoes disperses, a new group of mosquitoes move into the new pools of standing water left after the flood waters begins to recede. This new group of mosquitoes prefer habitats with calm, temporary or permanent pools of standing water to deposit their eggs. Many of the most important disease vectoring mosquitoes belong to this group of standing water mosquitoes and compose the second wave of mosquito invaders.

Neither the County nor the state has any available data on the health problems caused by mosquito invasions after coastal flooding events in Gloucester. This is most likely because such incidents are not always reported or confirmed to be directly related to the coastal flooding event. On April 16, 2007 Gloucester County adopted an Integrated Mosquito Management Program (IMMP) that is implemented through the Gloucester County Mosquito Control Commission (GMCC). This program is intended to specifically address mosquito control measures in the county. The county currently has five (5) Mosquito Control Districts which are all generally located in the southern half of the county; these districts were established in accordance with Section 32.1-187 of the Code of Virginia. The boundaries of these districts are discussed in the County Ordinance under Chapter 9.5 “Health and Sanitation”, Article II “Mosquito Control District.” For more information on the plan, see the Integrated Mosquito Management Program, 2007.

Fuel Spills and Chemical Waste

A long lasting hazard comes from flood water’s ability to mix and spread dangerous substances such as fuel or other chemical waste throughout a community. These materials also can seep into the ground water, causing serious health problems for people served by wells (Des Plaines Engineering Department, 2002).

A significant cause of fuel spills come from unanchored fuel tanks taken away by flood waters. When the water levels subside the scattered tanks can leak fuel onto the ground where it can be absorbed into the soil and gradually work its way into the groundwater (FEMA, 2006). Gloucester County’s building code mandates that all newly installed fuel tanks in a flood zone be securely bolted or strapped down to a concrete foundation. This provision acts as a safety measure to keep the tanks from floating away during flooding. Unfortunately, the mandate does not require pre-existing fuel tanks to be bolted or strapped down.

Chemical waste coming in contact with floodwaters is primarily caused by the amount of chemical waste stored in the average home (Des Plaines Engineering Department, 2002). In order to address this problem Gloucester County runs bi-annual household chemical collections in the southeastern portion of the county. The collection program can help to minimize the scattering of chemical waste during coastal flooding; the exact dates and times are advertised in the community newspaper, The Beehive.

Exposure to Raw Sewage Caused by Sewage Disposal System Failure

On-site sewage systems are susceptible to flood events and may result in the exposure of untreated sewage directly to humans or indirectly to humans via contact with creatures (e.g. dogs, cats, rats, flies, cockroaches, fleas or a host of others) that may have contact with the contaminated floodwater. Human disease contracted through direct or indirect exposure to untreated sewage includes Salmonella, Shigellosis, Cholera, Viral Hepatitis A, Gastroenteritis and Amebiasis. Untreated sewage that finds its way to local tidal waterways may contaminate shellfish harvesting areas and impact a major Gloucester industry.

Conventional sewage disposal systems are below ground and can naturally recover from flooding as flood waters subside and the soil dries. According to the VDH the primary

cause of damage to conventional systems is the uprooting of trees. As flood waters and rainwater saturate soils, trees become extremely susceptible to being uprooted/knocked over by strong winds. Overtime as a tree grows its roots may become entangled in nearby drain fields and if the tree is uprooted by strong winds, the drain field can be uprooted as well. According to the VDH the uprooting of trees during past storm events has been the number one cause of conventional septic tank damage in Gloucester County.

While uprooted drain fields can be avoided through the use of above ground alternative sewage disposal systems, during a storm event these systems experience their own problems and are extremely vulnerable to flooding events. Most alternative systems utilize mounds of sand to filter septic waste; these mounds as well as the systems which process the waste tend to be washed away during flooding events, releasing large amounts of untreated sewage. If the system is not washed away, these systems tend to be damaged by flood waters, debris or electrical outages. The mechanical parts that these systems rely on tend to break during or after a storm event. When damaged these systems fail to work properly and can back up and release large amounts of untreated sewage. Due to the increased use of this technology and the anticipated expansion of this use in flood prone areas, the public health, safety and economic impacts of development in these areas should be examined. This is especially critical in areas impacted by storm surge.

Damage or Destruction of Private Water Supply

Private water supplies, most often associated with drinking water wells, are significantly affected by flooding and are usually a first response issue after a disaster. The potential for contamination is present when well inundation with flood water that may be tainted by raw sewage or by chemicals released during a flood event occurs. Residents should not drink well water until it is tested.

Exposure to Mold Spores

Extensive water damage from flooding increases in the likelihood of mold contamination in buildings. Approximately 100,000 species of fungi exist but fewer than 500 fungal species cause infections in humans, generally through respiratory exposure. Infections from mold might be localized to a specific organ or disseminated throughout the body. Prolonged exposure to high levels of mold (and some bacterial species) can produce an immune-mediated disease known as hypersensitivity pneumonitis (CDC, 2006). After a flooding event buildings should be cleaned, dried out, and then inspected for signs of mold growth. If signs of mold are present, the building may need professional mold treatment or extensive structural repairs.

4. Goals

The following goals and objectives relate to appropriate actions that Gloucester County can implement to lessen the amount of damage caused by coastal flooding.

Goal 1: Protect public and private property from damage caused by coastal flooding hazard.

Objective 1.1: Prevent roadways in the county from being damaged during coastal flooding.

Objective 1.2: Protect new and existing development in the county's flood-prone areas from damages caused by coastal flooding hazard.

Objective 1.3: Protect critical facilities from being damaged during coastal flooding.

Goal 2: Maximize citizen actions to protect private properties.

Objective 2.1: Ensure that residents are given adequate warning of potential coastal floods.

Objective 2.2: Ensure that residents can easily obtain all general and property specific information relating to flooding and flooding risk.

Existing hazard mitigation strategies and recommendations for improvement are identified in Chapter 5.

5. Hazard Mitigation Activities

Over the years, the county has taken many steps to protect its citizens and property from flooding hazard. The county's current hazard mitigation activities can be grouped into the following categories:

1. Structural Improvement Activities
2. Preventative Activities
3. Property Protection Activities
4. Public Information Activities
5. Emergency Service Measures
6. Natural Resource Protection

In order to clearly distinguish the efforts the county has already implemented from this plan's recommendations for improvement; each will be designated as such. If there are no additional recommendations for improvement, the recommendation for the section will merely endorse the continuation of the county's existing effort.

5.1 Structural Improvement Activities

Structural improvement activities are a special type of mitigation project that aims to keep flood waters from damaging critical facilities. Structural improvement projects have many advantages as well as many shortcomings. When appropriate these improvements may provide long term protection against specific flood related damages. The shortcomings of these improvements depend on the nature of the improvement, but generally they are very expensive and require regular maintenance (Des Plaines Engineering Department 2002, 33).

The following structural improvement activities have been, or should be, implemented in Gloucester County:

- a. The Beaverdam Reservoir Dam
- b. Road Improvements

5.1a The Beaverdam Reservoir Dam

As discussed in earlier sections, the Beaverdam Reservoir is located in the central portion of Gloucester and it is contained by an earthen dam. The reservoir covers approximately 655 acres, and is surrounded by a 300 foot to 600 foot buffer of County owned forestland that makes up the Beaverdam Reservoir Park (Middle Peninsula Planning District Commission, 2005). The dam was constructed in accordance with plans approved by the Virginia Department of Conservation and Recreation (VDCR). In addition, VDCR has issued required operational certificates directing/confirming the safe operation of this facility.

What Has Been Implemented: There have been no flooding problems related to the dam structure serving the reservoir. Portions of the reservoir are located in flood zones AE and A, and according to county storm surge maps the downstream side of the dam itself has the potential to be inundated by a storm surge from a Category 3 hurricane. However, this does not pose any significant risk to the dam given it is designed to pass the probable maximum flood (PMF) which vastly exceeds a 100 year flooding event.

The dam's emergency spillway was tested during Hurricane Floyd in 1999 when the impoundment structure behaved as designed with water flowing downstream using the primary and emergency spillways.

There is no established database in Virginia of historic dam failures. However, most dam failures occur due to a lack of maintenance of the dam facilities in combination with excessive precipitation events, such as seasonal coastal storms or thunderstorms.

The Gloucester County Public Utilities Department conducts weekly inspections of the dam and provides regular maintenance to the facility. The county also participates in the National Dam Safety Program maintained by FEMA and the U.S. Army Corps of Engineers, which provides the county with dam safety research and training, and grant assistance opportunities to maintain dam safety. No improvements to Gloucester County's preventative measures against dam failure are needed.

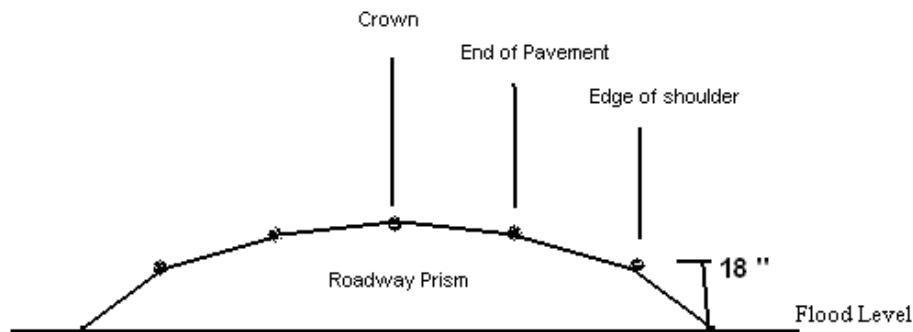
Recommendation 5.1a: The County should continue to regularly inspect the dam and perform regular maintenance, as well as continue to participate in the National Dam Safety Program.

5.1b Road Improvements

Gloucester County roadways are used as evacuation routes as well as the primary means for emergency responders to reach properties after coastal flooding events. Roadways damaged by coastal flooding can hinder emergency responders' ability to reach these areas. Roads in a flood zone can be damaged by floodwaters if they are built below prescribed levels of flood protection or without proper drainage (USDA, 1998).

What Has Been Implemented: The Virginia Department of Transportation (VDOT) utilizes specialized design criteria for protection of roadways against flooding. The Department's usual criteria are to have the lowest edge of the road shoulder elevated 18" above the prescribed level of flood protection (Figure 13). The prescribed level of protection are as follows: the ten year flood level for secondary roads, the 25 year flood level for primaries and arterials, and the 100 year flood level for emergency evacuation routes (VDOT, 2007).

Figure 13: Depiction of VDOT Prescribed Roadway Section

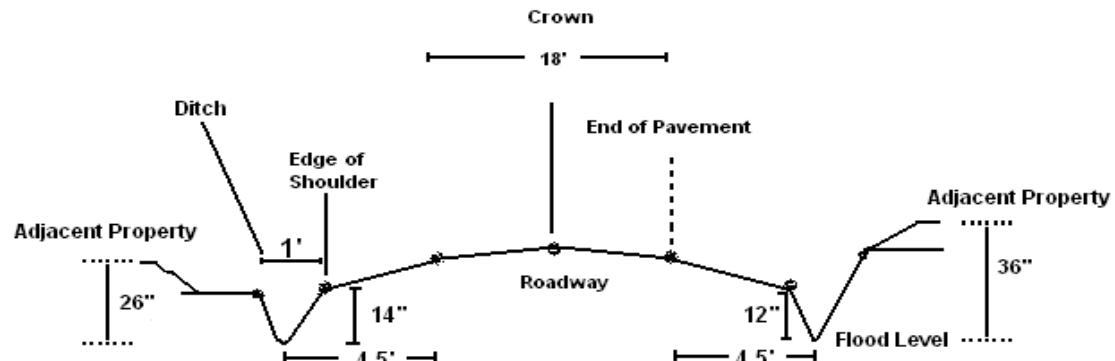


Source: VDOT, 2007

Under the Byrd act of 1932, VDOT assumed responsibility for all the public roads in Gloucester County. The majority of roads in the county that serve coastal areas predate

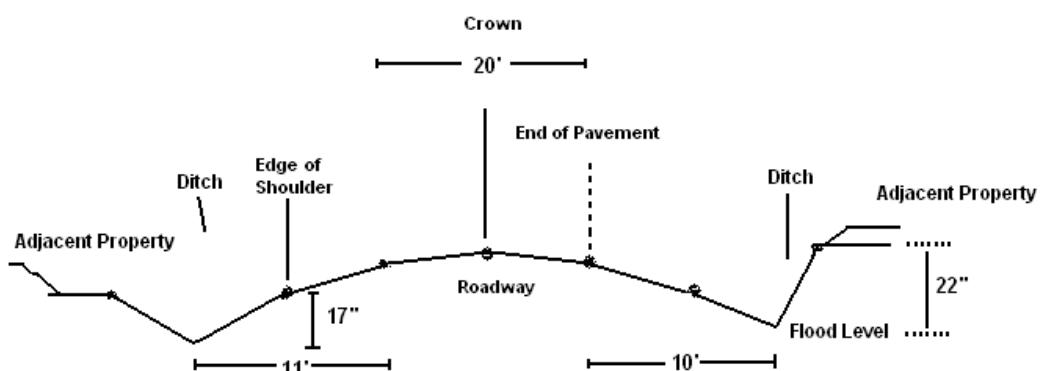
Gloucester County's FIS and FIRM which provide base flood elevations. Thus the exact identification of the appropriate flood level was not used to protect these roads. The figures below depict various road segments in the southeastern portion of the county, all of which are built differently than the prescribed roadway above (Figure 13). The figures below depict the variable lengths or lack of shoulders along the roadways, the variable depth or lack of ditching along roadways, and the height of adjacent property to that of the roadway's pavement.

Figure 13a: Depiction of Roadway Section at 2339 Low Ground Road



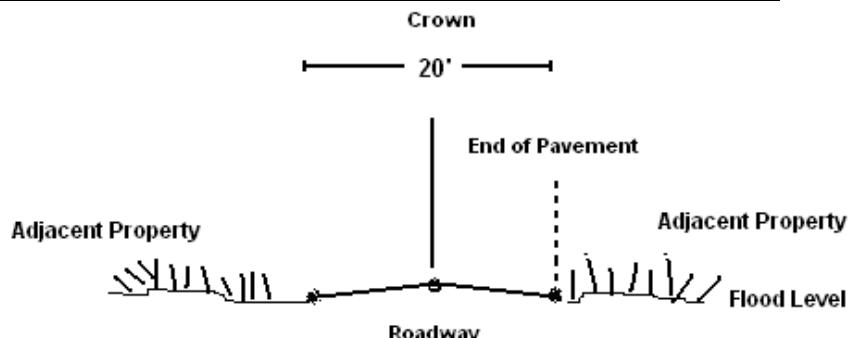
Source: Field Survey, 2009

Figure 13b: Depiction of Roadway Section at Haywood Seafood on Maryus Road



Source: Field Survey, 2009

Figure 13c: Depiction of Roadway Section at 10021 Maryus Road



Source: Field Survey, 2009

VDOT also uses roadway drainage crossings to protect roads from flooding; these crossings divert tidal streams under roadways through culverts (Figure 14). This protection measure prevents tidal streams from eroding land the road is built on, avoiding damage to the road (USDA, 1998). Roadside ditches are used to drain rainwater from roadways (Figure 15). During the three community meetings many citizens commented on the amount of debris and sediment clogging the area's ditches, causing the flooding problem in the southeastern portion of the county to be exacerbated during coastal storms.



Figure 14: Roadway Drainage Crossing in the Southeastern Portion of the County.



Figure 15: Roadside Ditch in the Southeastern Portion of the County.

Inadequate drainage problems arise when water volume surpasses the culvert's capacity, forcing water to either side of the culvert or over the road, causing erosion of the roadway segment (Figure 17), (USDA, 1998). Clogged culverts can hinder the performance of the roadway drainage crossings, causing damage to the road. Debris carried by floodwaters can become lodged inside or around the entry of the culvert, preventing water from flowing under the road (Figure 18). Water is then forced to either side of the culvert, or over the road, causing erosion and eventual damaging the road (USDA, 1998). When the flow of floodwaters is allowed to spread out laterally prior to entering a culvert, debris can accumulate and increase the chance of clogging the culvert (Figure 18), (USDA, 1998). Figure 17 is an example of a culvert inlet that is too wide, increasing the chance of clogging. In order to avoid clogging; the culvert's inlet basin should be designed to maintain the natural channel configuration of the stream, promoting debris passage through the culvert (Figure 19), (USDA, 1998).

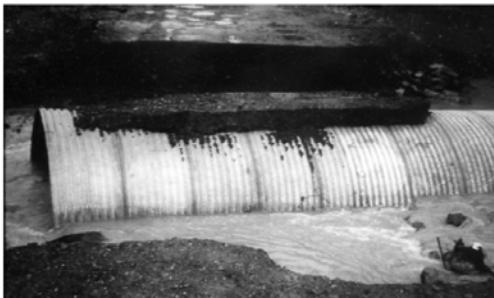


Figure 16: Example of Damaged Roadway Drainage Crossing
Source: USDA, 1998

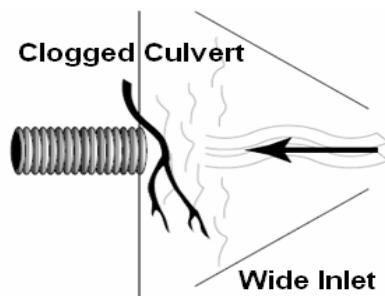
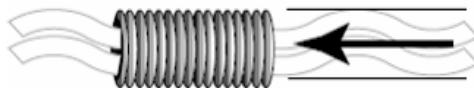


Figure 17: Example of a Clogged Culvert Caused by a Wide Inlet Source: USDA, 1998

Figure 18: Culvert Inlet that Maintains Natural Channel Configuration



Source: USDA, 1998

Recommendations for Improvement: It is recommended that in order to maintain culverts and ditches in the southeastern portion of the count that a semiannual ditch maintenance program be created. The maintenance program will designate who is responsible for clearing ditches and culverts as well as establishes who will pay for such services, and establish a schedule for semiannual maintenance. The possibility of utilizing incarcerated individuals from the County Jail to clear ditches should be looked into. VDOT in combination with County officials should be involved in the preparation of this maintenance program.

Unfortunately, VDOT does not keep records of which roads flood and when. In an effort to identify the roads that are most vulnerable to damage from coastal flooding, road closure data was obtained from VDOT.⁵ A seven year time frame (1999 – 2006) was considered because of the likelihood that the roads have not been structurally improved since 1999 and because of the relevance of the most recent storm events: 1999’s Hurricane Floyd, 2003’s Hurricane Isabel, and 2006’s Hurricane Ernesto. During this time frame there has only been one road in the southeastern portion of the county (on one occasion) that has been closed⁶ due to flooding - Rte. 649 (Maryus Road) from Hurricane Ernesto in 2006. There have been no other closures⁶ in the southeastern portion of the county during the 7 year time frame. Per VDOT recommendation Route 646 (Jenkins Neck Road) will be considered as a high risk road because it has flooding during every coastal storm event in recent years. For purposes of relevance road closure data for the rest of the county focuses primarily on roads that have been closed⁶ on two or more occasions due to flooding during the seven year period (Table 7).

Table 7: Road Closures due to Flooding from 1999 - 2006

Rte.	Road Segment
605	Indian Road at Beaverdam Reservoir.
606	Farys Mill Road at Beaverdam Park second entrance.
610	Salem Church Road at the fourth bend.
614	Featherbed Lane at second bend.
614	Segment: Hickory Fork Road at Haynes Mill Pond. (<i>This road segment was fixed in 2006 and has not been closed since</i>).
625	Ditchley Drive nearest the North River.
662	Allmondsville Road at the bend.
1208	Greate Road at the boat landing.

Source: VDOT, 2007

⁵ The road closure data does not describe the cause of flooding; the information merely informs us which road segments experienced closures due to flooding and when they were closed.

⁶ A road closure by VDOT is caused by damages to the road which make it impassable, such as washout. Closures caused by downed trees were not considered in this list, nor was a temporary “closure” caused by standing water considered in the list.

What Has Been Implemented: According to VDOT, a triple line of pipe on State Route 649/Maryus Road was replaced in the summer of 2006 and the segment was elevated approximately one (1) foot. Also, in September of 2006 VDOT completed a construction project which relocated Route 614 from the Haynes Mill Pond dam to a bridge several hundred yards downstream. The road over the dam has not been officially abandoned, but it is blocked off and no longer in use. Other than the above mention there have been no other major elevation improvements to the roadways in the county that have experienced damage from flooding within the last seven years. When a road segment is damaged by flooding; it initially receives an emergency repair, and later when funds become available is rebuilt to current VDOT standards.

Recommendations for Improvement - Due to the costs associated with road construction and the limited funds available each year, it is not currently feasible for the county to implement structural improvements on each of these roads. Thus a priority listing was created to indicate which road segments should be improved before others. Priority was given to road segments that support the largest number of pre-FIRM structures in a flood zone. Most pre-FIRM structures were not built with flood-proof techniques and are vulnerable to flooding. The number of unmitigated pre-FIRM structures in each flood zone was obtained through county GIS maps and county property records. All of the roads in the study are secondary roads. Because Maryus Road and Haynes Mill Pond have received alterations in recent years, these roads were not considered in the priority list, the county should continue to monitor these roadways before and after a flooding event, if they continue to receive damage due to flooding they will be placed back on the road improvement priority list.

Road Improvement Priority List

1st Priority: Rte. 646 (Jenkins Neck Road)

The road supports over 100 structures, of which 90 are estimated to be pre-FIRM in a flood zone.

2ndPriority: Rte. 625 - Segment: Ditchley Drive nearest the North River

The road segment supports 65 structures, 27 are pre-FIRM in a flood zone.

3rdPriority: Rte. 662 - Segment: Allmondsville Road at the bend

The road segment supports ten structures; six are classified as pre-FIRM in a flood zone.

4thPriority: Rte. 614 - Segment: Featherbed Lane at the second bend

The road segment supports 15 structures; three are classified as pre-FIRM in a flood zone.

5thPriority: Rte. 610 - Segment: Salem Church Road at 4th bend

The road segment supports three structures; one is classified as a pre-FIRM in a flood zone.

6thPriority: Rte. 605 - Segment: Indian Road at Beaverdam Reservoir

The road segment supports eight structures; none are classified as pre-FIRM or in a flood zone.

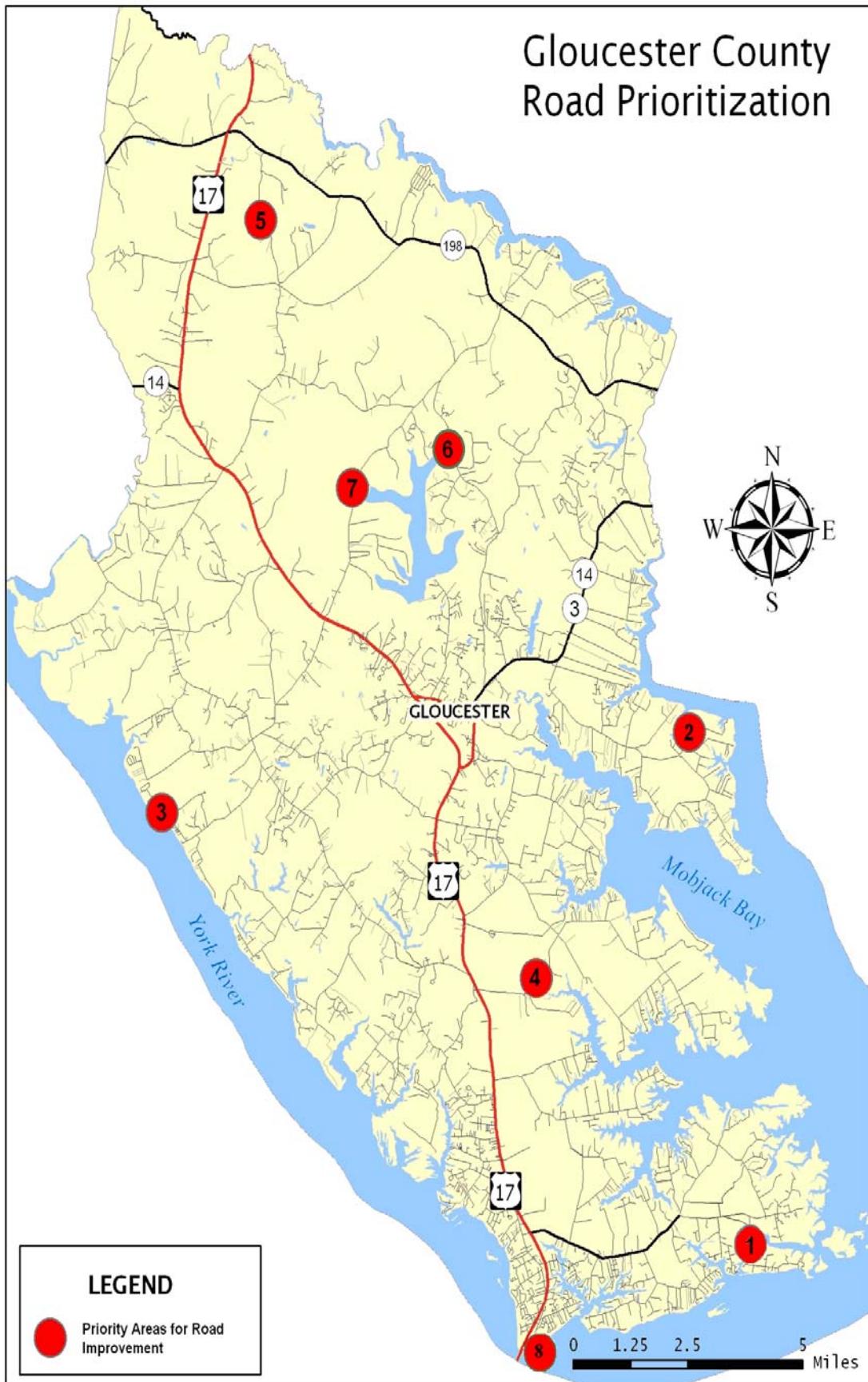
7thPriority: Rte. 606 - Segment: Farys Mill Road at Beaverdam Park second entrance

The road segment supports no structures.

8th Priority: Rte. 1208 - Segment: Greate Road at the boat landing
The road segment supports no structures.

The roadway improvement priority list for Gloucester County is visually depicted in Figure 19.

Figure 19



Source: County Base GIS layers were provided by United States Census Bureau.

To further address the road conditions of the southeastern portion of the county, VDOT staff was asked to determine the extent to which the area's roads must be raised to meet the agency's prescribed level of protection (see Appendix C). However, because there has been only one road closure⁶ in the southeastern portion of the county (Maryus Road) during the last three hurricane events it can be assumed that the majority of this area's roads were built to the prescribed level of protection or utilize adequate road drainage crossings. Maryus Road experienced a closure⁶ from Hurricane Ernesto in 2006 because a roadway drainage crossing washed out during the storm. The exact cause of the washout is unknown; it could have been caused by lack of elevation and or by inadequate drainage crossing.

According to VDOT's prescribed level of protection; Maryus Road should be elevated above the ten year flood level (see Appendix C). To structurally improve Maryus Road to withstand floodwaters, sections of the road that have been closed due to flooding should be elevated to VDOT's prescribed protection level of the 10-year flood level and the number and size of culverts under the roadway should be increased and properly designed to allow coastal flood waters to flow freely. As mentioned earlier VDOT has since replaced a triple line of pipe on Maryus Road and elevated the segment approximately one (1) foot, continued monitoring of the roadway is needed and if problems with flooding persist, structural improvement activities should be considered.

Roadway Signage

It was expressed through citizen comment that there are many other roads in the county which have frequently flooded in addition to those which have been officially closed by VDOT. Low lying roads in the county become extremely dangerous or impassable as floodwaters rise. In some instances residents who are attempting to evacuate the area are forced to drive through standing water on flooded roadways. This is very dangerous and vehicles can easily lose contact with the road surface and hydroplane off the road or become buoyant and possibly be carried away by high-waters. Various localities throughout the nation employ warning signs that measure height of water to warn drivers of water depths atop of roadway surface.

What Has Been Implemented: Currently VDOT does not keep records of which roads in the county frequently flood. Nor does VDOT employ flood warning signs on frequently flooded roads before a storm event, but rather only after a flooding occurrence do they place temporary portable "Caution High Water" signs on roadways where standing water is reported after a flooding event.

Recommendations for Improvement: The County should keep detailed records of which roads in the county flood, how often and to what extent. Permanent signage should be placed along all frequently flooded roadways in the county. These signs should warn of the flooding hazard as well as provide gauges that allow drivers to determine how deep standing water on the road's surface is (Figure 20).



Figure 20: Example of a Roadside Flood Gauge
Source: Google

Recommendation 5.1b1: The County should utilize the road improvement priority list to prioritize the allocation of scarce resources to projects that support the largest number of unmitigated pre-FIRM structures in the SFHA.

Recommendation 5.1b2: The County should continue to monitor State Route 649/Maryus Road and if washouts from flooding persist should improve the road to withstand coastal floodwaters by elevating damaged sections and installing more appropriate roadway drainage crossings.

Recommendation 5.1b3: The County should develop a semiannual ditch maintenance program for the southeastern portion of the county.

Recommendation 5.1b4: The County should keep detailed records of which roads in the county flood, how often and to what extent.

Recommendation 5.1b5: The County should consider permanent road signage with gauges that mark high water on frequently flooded roads in the county.

5.2 Preventative Activities

Preventative activities aim to minimize the amount of future development in the flood hazard area and prepare both pre-existing and new development in the hazard area to withstand flooding. Preventative activities can be implemented and enforced only by the local government (Des Plaines Engineering Department, 2002).

The following preventative activities have been implemented in Gloucester County:

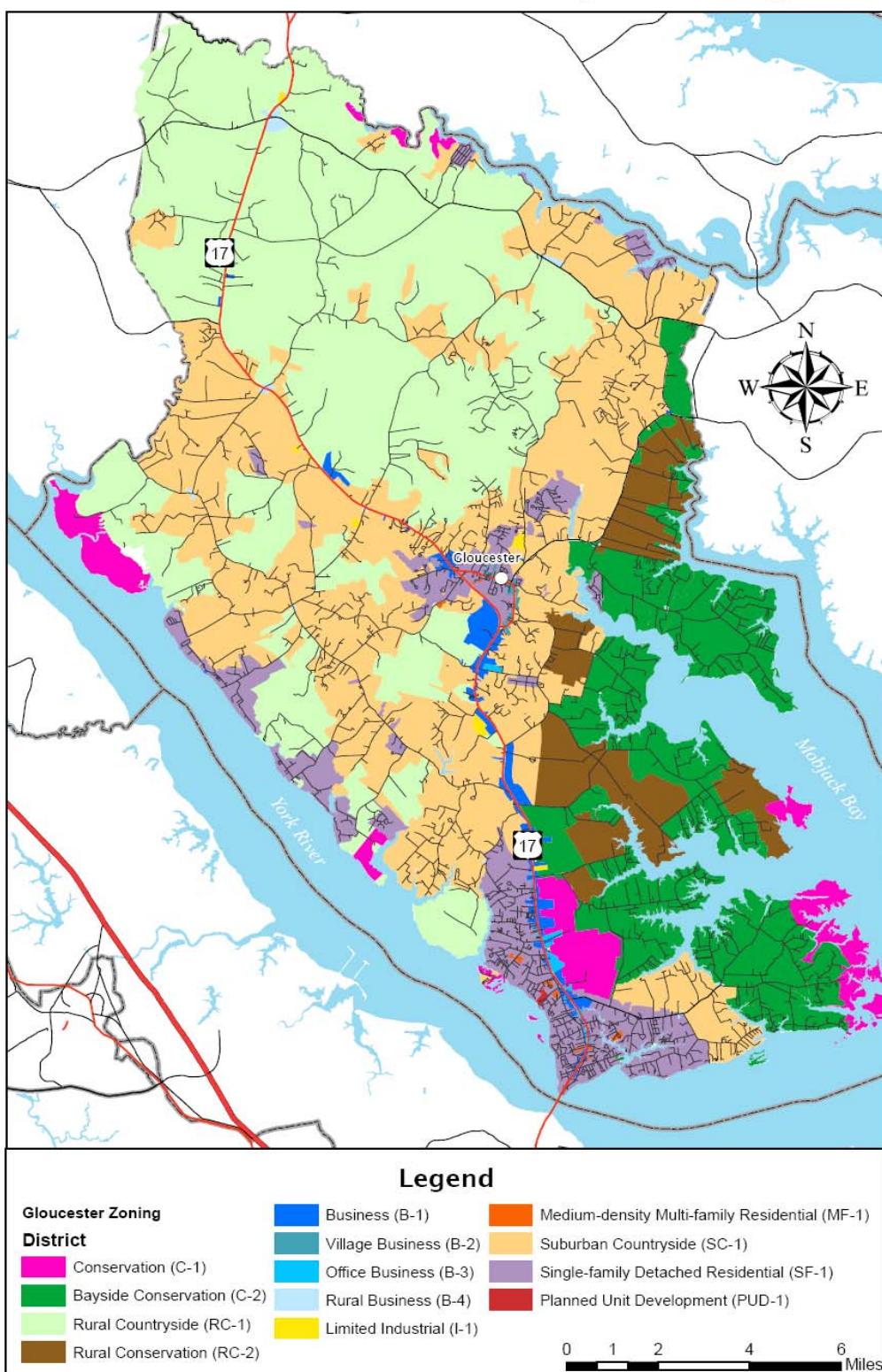
- a. Planning and Zoning
- b. Building Regulations
- c. Floodplain Development Regulations

5.2a Planning and Zoning

Gloucester's Comprehensive Plan was adopted in 1991 and has been updated numerous times, most recently in November of 2001 with the addition of the Natural Resources and Environmental Quality Chapter to comply with the Chesapeake Bay Preservation Act. The major themes of the plan are growth management, preservation of rural character, and protection of environmental resources. The plan relies on the county's zoning ordinance to establish and enforce land use designations. The county's zoning ordinance was last updated in 1998. Figure 21 depicts the zoning for the entire county and Figure 22 provides a more detailed view of the zoning for the southeastern portion of the county.

Figure 21

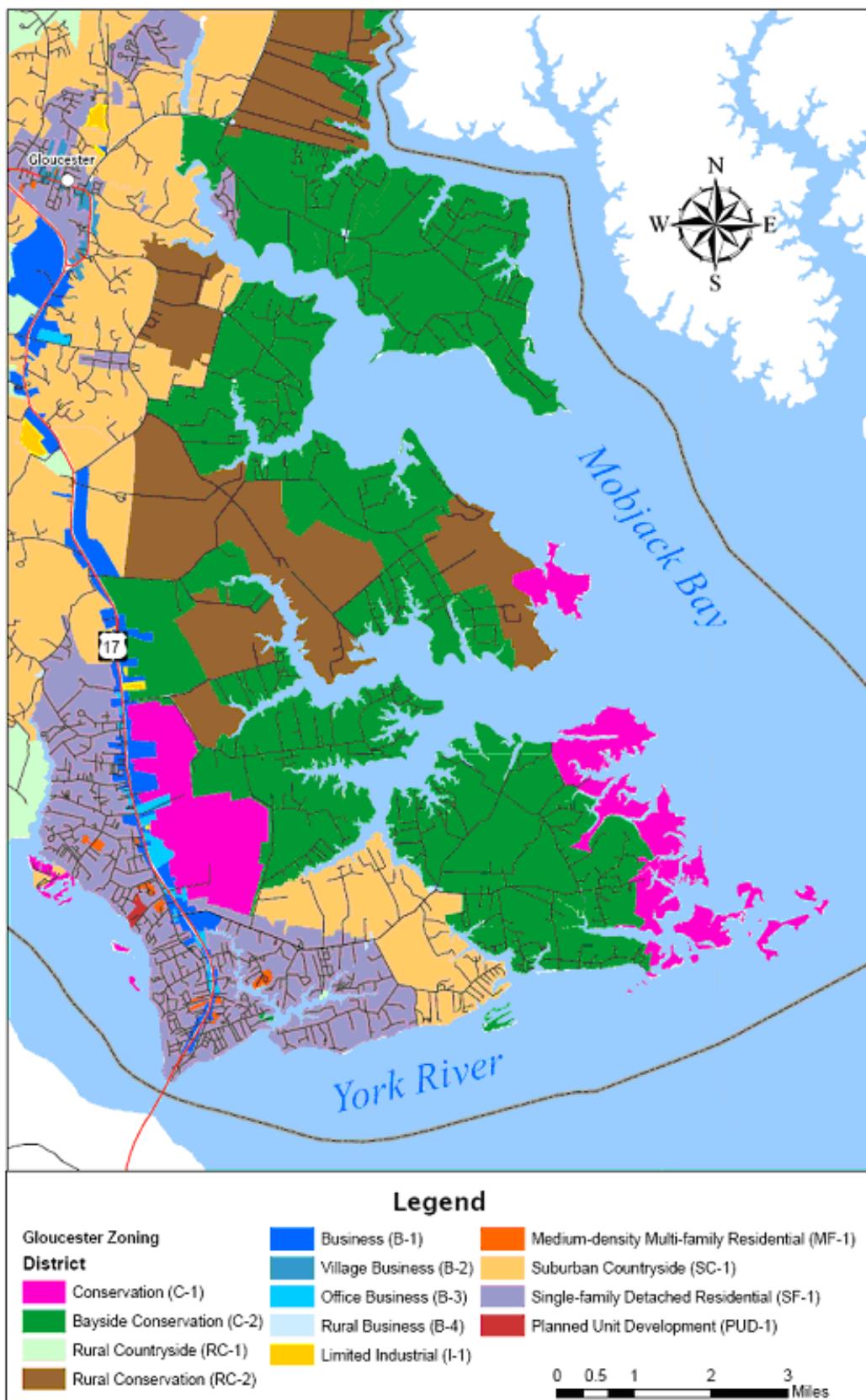
Gloucester County Zoning



Source: County Base GIS layers were provided by United States Census Bureau and the County Zoning GIS layers were provided by Gloucester County Information Technology/ GIS Department.

Figure 22

Gloucester County Zoning (Southeastern Portion Inset)



Source: County Base GIS layers were provided by United States Census Bureau and the County Zoning GIS layers were provided by Gloucester County Information Technology / GIS Department.

What Has Been Implemented: The zoning maps show that the vast majority of the county's flood-prone areas are currently zoned Conservation (C-1), Bayside Conservation (C-2), and Rural Conservation (RC-2), all of which allow for low density development. Each of these designations has a minimum lot size requirement for new development and promotes clustering (Table 8).

Table 8: Zone Lot Size Requirement

Zone	Lot Size Requirement
Conservation (C-1)	No new development permitted
Bayside Conservation (C-2)	One dwelling unit per 5 acres
Rural Conservation (RC-2)	One dwelling unit per 5 acres
Suburban Countryside (SC-1)	One dwelling unit per 2 acres
Single Family Residential (SF-1)	One dwelling unit per 2 acres (<i>without sewer & water</i>)
Single Family Residential (SF-1)	One dwelling unit per 30,000 SF (<i>sewer & water</i>)

Source: Gloucester County, 1991

The minimum lot size requirement helps to limit the number of houses in the area. During major coastal flooding fewer structures in the flood-prone area means less potential for damage.

The county's Comprehensive Plan encourages clustering in each of these zones to protect the area's scenic and environmental features through the preservation of open space and to facilitate floodplain management activities. Clustering works by keeping larger lots from being subdivided into smaller lots, yet allows the same number of structures to be built. Clustering can be used to protect structures that develop within various portions of the county's flood-prone area (National Research Council, 2006). For properties located further inland but still within a flood-prone area, clustering can prevent damage to structures by locating them on higher ground. Rather than subdividing a 25 acre lot into 5 acre sub lots where multiple properties would sustain damage during minor flooding events, clustering can keep most of the 25 acre lot undeveloped and allows owner to sell development rights to five potential home owners who can cluster their houses on the highest area on the 25 acres (Figure 23). This helps avoid flood damage for all of the properties built on the original lot.

Figure 23: Clustering Inland

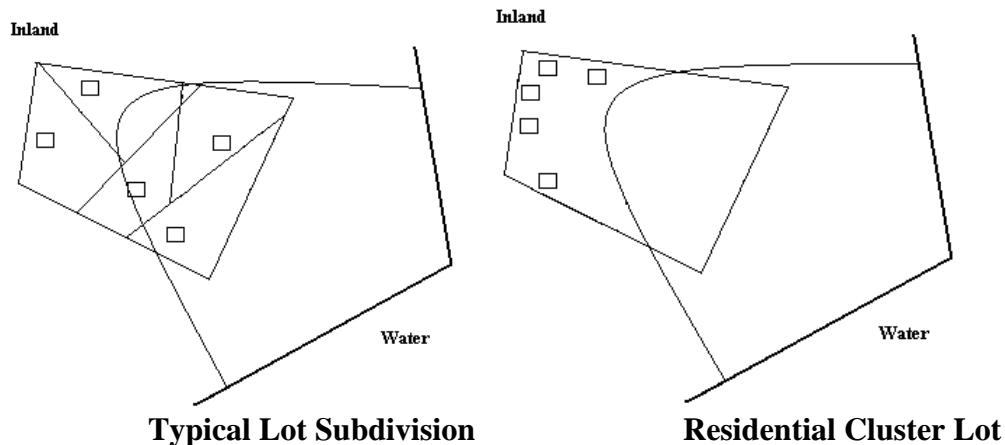
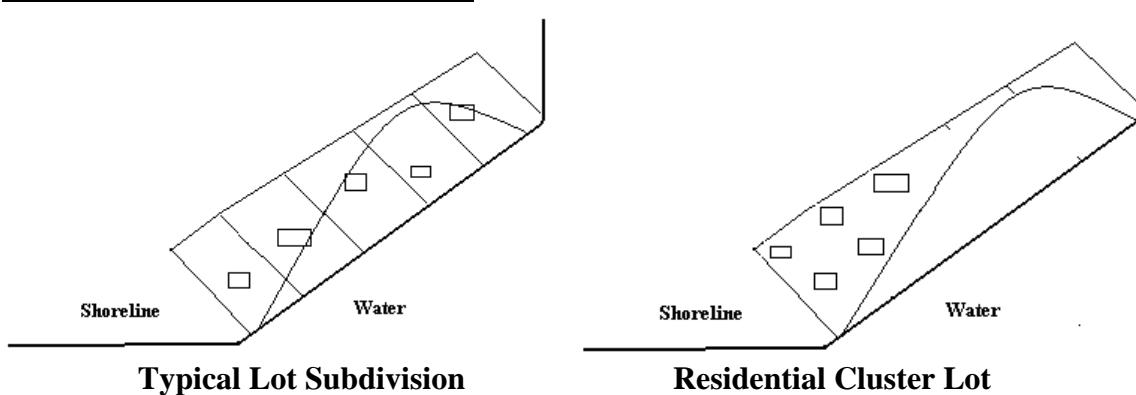


Figure 24 shows how clustering can protect structures developed on the coast by building structures in reduced wave hazard areas on the lot.

Figure 24: Clustering on the Coast



During major coastal flooding events within the county, such as a Category 2 Hurricane surge, the complete inundation of the southeastern portion of the county is likely and thus clustering does not provide as much a benefit to development than during minor flooding events.

Recommendation 5.2a: The County should continue to zone for low density development and encourage residential clustering within flood-prone areas.

5.2b Building Regulations

The implementation of flood-resistant building regulations for new construction can create safer communities across the county. These standards include criteria to protect buildings from forces of nature associated with hurricanes, such as high winds and heavy rainfall (Des Plaines Engineering Department, 2002).

What Has Been Implemented: The Virginia Uniform Statewide Building Code (USBC) prescribes mandatory building regulations for construction, maintenance, grading and proper drainage of structures to prevent water damage to the building. Gloucester County Codes and Compliances Department Building Inspectors conduct regular inspections throughout the construction process, including foundation, exterior and interior framing, electrical, and plumbing (Gloucester County, 2007).

The county's Subdivision Ordinance governs how land will be subdivided into individual lots and mandates subdivision standards and procedures in regards to the construction, location and infrastructure that will serve the lots, including sidewalks, utility lines, sidewalks, and drainage ways (Gloucester County, 2007). Gloucester County building regulations are governed by state law and are adequate.

Recommendation 5.2b: Gloucester County should continue to enforce building regulations throughout the county.

5.2c Floodplain Development Regulations

The National Flood Insurance Program (NFIP) sets minimum standards for participation in the program. The majority of the provisions are in the county's building code and

subdivision ordinance. Others are accounted for in the county's Floodplain Management Ordinance, which was adopted in 1987 to manage present and future development in flood-prone areas.

What Has Been Implemented: The Ordinance delineates and describes six flood districts (Figure 9) and general development provisions for each (Table 9). The Ordinance also mandates a permit requirement and a Design Flood Elevation (DFE) requirement for all development in a flood zone (Gloucester County, 2002).

Table 9: Development Provisions for Flood Districts

Zone	Inundated by 100 year Flood	Base Flood Elevations Shown	Mandatory Flood Insurance
AE	Yes	Yes	Yes
A	Yes	No	Yes
VE and V	Yes	Yes	Yes
X and X500	No	No	No

Source: Gloucester County, 2002

The development provisions establish general and specific requirements for all development in each flood district according to the type of flooding that the area encounters. The development provisions for zones V and VE establish where and how to build the structure in order to avoid damage from wave action, while provisions for zones A and AE establish how to build the structure in order to avoid still-water flooding (see 5.3a Elevation and Acquisition Projects section of this plan for additional details on building provisions).

The permit requirement mandates the identification of the proposed structure's lowest flood elevation, existing ground elevation, and the 100 year flood elevation. The permit also requires identification of the method for elevating the proposed structure. These requirements help County officials keep track of development in the flood zone.

The Gloucester County Design Flood Elevation requirement mandates that all new construction and substantially damaged structures (those facing restoration costs of up to 50% of the total value of the structure before the damage occurred) in a flood zone be elevated at least one additional foot above base flood elevation. This requirement exceeds the NFIP's minimum standard by requiring the additional foot as the minimum, and helps to better protect new development from the type of flooding the county experiences. (See 5.3a Elevation and Acquisition Projects section of this plan for additional details on benefits of elevation.) No improvements to Gloucester County's Floodplain Management Ordinance are needed.

Recommendation 5.2c: The county should continue to require and enforce the provisions of the Floodplain Management Ordinance.

5.3 Property Protection Activities

Property protection activities consist of modifications of pre-existing structures to protect against flood damage. Most activities are managed and funded by individual property owners, but local government can encourage property protection activities by seeking financial assistance for the community through government grant programs (St. Tammany Parish, 2004).

Property protection activities in Gloucester County have been implemented through:

- a. Elevation and Acquisition Projects
- b. Purchasing Flood Insurance

5.3a Elevation and Acquisition Projects

Structural elevation can reduce or eliminate future flood damage, lower flood insurance premiums, add value to the house and increase parking and storage space in the house. The elevation method applied to a structure depends on the flood zone designation. If a structure is located in an area with high wind velocity and wave action (VE and V zone), elevating can be done only through the use of columns or piles which are embedded sufficiently below the soil to withstand erosion (Figure 25). This allows water and floating debris to flow under the structure, thereby avoiding structural damage (FEMA, 1994). If a structure is located in an area with potential for only low to moderate water depth and velocity (AE or A zone) elevating above the base flood elevation (BFE) may only require raising the structure using a solid wall elevation technique (Figure 26). This technique uses steel supports to raise the structure and then extends the foundation walls. However, the enclosure area under the building must have openings to allow for the entry and exit of flood waters to avoid hydrostatic forces which could cause the structure to collapse (FEMA, 1994). Both of these techniques can also be used to elevate pre-existing structures above the BFE. Gloucester Volunteer Fire and Rescue Department have warned that their current equipment is limited in flood related scenarios with structures elevated over 30 feet. They currently have an aerial device which has a height of 95 feet, however in areas affected by flood this apparatus may not be able to respond due to terrain and the weight from the vehicle. If there were a situation that would require them to perform a rescue from a residence the longest ground ladder they carry is 35 feet in height. They ask that when or if structures are raised that the highest window not exceed 30 feet for rescue purposes.

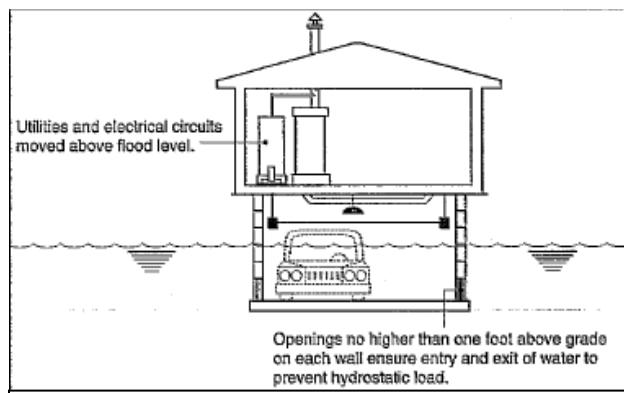


Figure 25: Typical Residential Elevation within a VE and V Zone
Source: FEMA, 1994

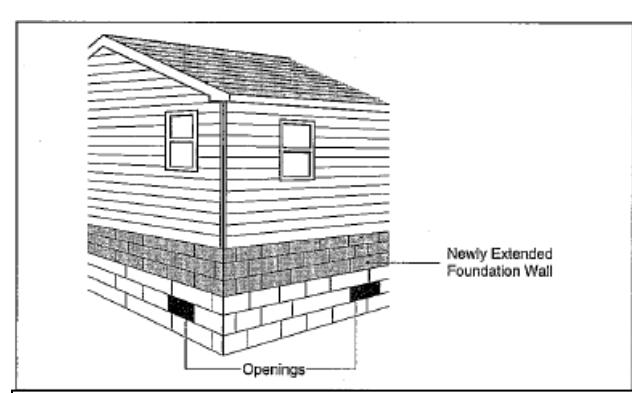


Figure 26: Typical Residential Elevation within an AE and E Zone
Source: FEMA, 1994

Property acquisition can reduce flood vulnerabilities within a community, protect sensitive habitats and provide opportunities for recreational use. This requires local government to buy property from residents in flood-prone areas and turn the properties into open space which can be made into recreational areas for the community. There are two types of acquisition projects: (1) basic acquisition and demolition, and (2) acquisition and relocation of structures to areas outside of the flood zone (FEMA, 1998). Residents wishing to relocate outside of the flood zone can sell their property to the local

government at fair market value and use the money to relocate beyond the flood-prone area. The strength of this type of property protection depends on the county's acquisition program and the severity of flooding in the community (FEMA, 1998).

What Has Been Implemented: The elevation and acquisition of properties significantly reduces flood damage to new and pre-existing development in the flood zone. Unfortunately, both are very costly endeavors. For residents who cannot afford the costs associated with these mitigation techniques, the county actively pursues and organizes grant funding opportunities, when funding is available. As an eligible community under the FEMA Hazard Mitigation Grant Program (HMGP), the county can apply to receive funding for the acquisition, demolition, and elevation of damaged structures after major coastal storms hit the area. The amount of funding received through the program is determined by the amount of damage sustained during the event and the strength of the grant proposal. Residents who are interested in receiving financial assistance to elevate their home can place their name on a list that the county refers to when considering which properties to offer a slot on the grant proposal. The county has an active and on-going Hurricane Residential Recovery Program in the southeastern portion of the county. The county has successfully applied for and received grant funding from HUD/VDHCD as well as FEMA/VDEM to implement the program.

A HUD/VDHCD Grant was awarded to Gloucester under the Urgent Needs Grant Program after Hurricane Isabel in 2003. This \$700,000 grant was used to elevate and reconstruct seven (7) homes in the SE portion of the county. These properties did not receive new foundations but rather new walls, kitchens and electrical.

There have been three (3) rounds of Post Disaster Mitigation (PDM) Funds awarded to the county through the FEMA/VDEM Hazard Mitigation Grant Program. These were awarded after Hurricane Isabel, Tropical Storm Gaston and Tropical Storm Ernesto to once again repair damage to the SE portion of the county.

The post Hurricane Isabel FEMA Hazard Mitigation Grant amounted to just over \$4,000,000 and was expended in two (2) phases. There were a total of 51 properties that were approved for assistance. Through May 1, 2009, twenty one (21) houses have been elevated, (10) other properties have been purchased and the houses on them will be demolished, five (5) houses await elevation and three (3) other properties are pending sale to the county.

In terms of acquisition, the county currently has a list of properties that are being acquired using FEMA HMGP funding from Hurricane Isabel and Tropical Storm Gaston. As a requirement to receive these funds the county developed and adopted an Open Space Management Plan in 2009. The purpose of this plan is to protect and conserve county land, wetlands, and water for current residents and future generations. The Plan involves the acquisition of sixteen properties that were enrolled in the program on a volunteer basis, both with residential houses, which will be demolished per the terms of the HMGP, and properties currently still in their natural state. Specifically, the Plan will allow the county to: 1) Eliminate private property damage and loss of life through clearance of residential homes, 2) Create opportunities for wetland mitigation, 3) Provide an opportunity for a small nature trail for local school children and 4) Provide land for future recreation opportunities for all county residents and visitors.

The post Tropical Storm Gaston FEMA Hazard Mitigation Grant award was for \$208,000 and it will be used to elevate 3 houses. This project is scheduled for completion by December 2008.

The post Tropical Storm Ernesto FEMA Hazard Mitigation Grant was approved for \$1,008,000 to elevate 12 properties as well as install “quick connects” for generators to county shelters. These will be located at Peasely Middle School, Bethel Elementary School and Botetourt Elementary School.

The county has hired the Richmond- based planning firm, K.W. Poore and Associates, to write the grant application and to manage these projects once funded. The county plans to pursue additional grant funding opportunities to continue with the residential mitigation activities.

Recommendations for Improvement: Due to the time consuming nature and high cost of structural elevation, County officials currently estimate that it will take until 2018 to elevate all structures on the list. For this reason the plan focuses its efforts on voluntary property acquisition as a priority in the flood zone. The guidelines of this program state that any property under consideration to be acquired must enter the process voluntarily. A large number of property owners in the flood zone might like to sell their property to the county, but due to the amount of affected buildings and the limited availability of grant funds the county cannot acquire every one of these properties. Thus a priority list for property acquisition was created to indicate which properties should be acquired before others. A set of criteria was followed to help determine which properties should be considered for acquisition first. These were based on FEMA’s Hazard Mitigation Grant Program requirements, criteria suggestions found in the FEMA “Property Acquisition Handbook for Local Communities: A Summary for States”, the overall goals of this plan, and the open space preservation goals stated in the Comprehensive Plan of Gloucester County. In general the criteria promote; an increase in the amount of land preserved as open space, and a reduction in the amount of flood damage to new and existing properties in the flood prone areas of the community. Properties recently elevated were omitted from prioritization because they have already received flood mitigation efforts. Also, water-related commercial properties were omitted because of their assumed acceptance of risk. The criteria used are as follows:

Priority 1: Properties that have suffered repetitive losses from flooding.
Data obtained from repetitive loss list.

Priority 2: Properties containing residential structures.
Data obtained from repetitive loss list.

Priority 3: Properties adjacent to previously acquisitioned lots.
Data obtained from county property records and GIS maps.

Priority 4: Properties in the same neighborhood as previously acquisitioned lots.
Data obtained from county GIS maps.

Priority 5: Properties on four acres of land or more.
Data obtained from county property records.

Priority 6: Properties that have access to natural resources (forest or waterfront).

Data obtained from county GIS maps.

Priority 7: Vacant lots

Data obtained from county property records.

The property acquisition priority list for Gloucester County is found in Table 10.

Table 10: Suggested Repetitive Loss Acquisition Priority List

Suggested Repetitive Loss Acquisition Priority List			
Property Address	Acres	Natural Resources	Vacant
1111 Severn Wharf Rd	2	Yes (water)	No
2222 Guinea Circle	4	No	Vacant
3333 Glass Rd	4	No	No
4444 Maundys Creek Rd	1	No	No
5555 Jenkins Neck Rd	2	Yes (water)	No
6666 Clements Ln	1	Yes	Vacant
7777 Jenkins Neck Rd	.5	Yes (water)	No
8888 Lucilles Ln	1	Yes (trees/ water)	No
9999 Moores Landing Ln	8	Yes (water & trees)	No
10 Thornton Ln	16	Yes (water & trees)	No
11 Horse Rd	0	Yes (water)	No
12 Kings Creek Rd	NA	No	No
13 Sandy Pines Ln	0	Yes (water)	No
14 Thornton Ln	16	Yes (water)	No
15 Ware Point Rd	NA	Yes (water & trees)	Vacant

This priority list is made up of fictitious data; the true data can not be published due to provisions of The Privacy Act. This list is given as an example of what the actual list contains.

Recommendation 5.3a: The County should seek to acquire properties through voluntary programs according to the priority list in order to increase the amount of land preserved as open space, and to reduce the amount of flood damage to new and existing properties in the flood prone areas of the community.

5.3b Purchasing Flood Insurance

Flood insurance is not a strategy to avoid flood damage; it merely helps offset the costs of repairing or rebuilding a property after flood damage has occurred. The purchase of flood insurance is a smart investment for any home owner. It has been reported that select private insurance companies are “blue lining” the Tidewater area for flood insurance. Allstate has recently stopped writing new flood insurance policies in 19 coastal communities: Accomack, Gloucester, Isle of Wight, King and Queen, Lancaster, Mathews, Middlesex, Northumberland, Northampton, Southampton, Surrey, Sussex, York counties and Chesapeake, Franklin, Hampton, Newport News, Norfolk, and Virginia Beach. Nationwide is also withdrawing from any new coastal coverage in Gloucester, Mathews, areas in Middlesex, and areas in Essex. State Farm reportedly will not write new flood insurance policies within one mile of shoreline. These three private

insurance companies make up 55% of the private insurance market in Mid-Atlantic Region (Middle Peninsula Planning District Commission, 2009).

What Has Been Implemented: In 1987, Gloucester became a participating community in FEMA's National Flood Insurance Program (NFIP). This participation enables citizens to obtain federally backed flood insurance for their properties based on the property's location. As a participating member of the NFIP, Gloucester became eligible to join the CRS program. While participation in the program is voluntary, the benefits for citizens are great. Under the program, flood insurance premiums are modified based on a point system related to the community's efforts to reduce future flood damage and go beyond the minimal national standards. The county currently has approximately 1,528 flood insurance policy holders (Middle Peninsula Planning District Commission, 2005).

Recommendations for Improvement: To gain further reductions in flood insurance policy premiums the county must gain credits that will qualify the locality for a lower CRS rating. One way to gain CRS credit is through the preparation of a floodplain management plan for the county, which describes ways to improve existing flood mitigation techniques.

Recommendation 5.3b: The County should adopt this Coastal Floodplain Management Plan to help strengthen the community's mitigation activities as well as lower insurance premiums for policy holders.

5.4 Public Information Activities

Conducting public information sessions and providing citizens with all available information relating to the hazards and protection measures will help strengthen the community's overall resistance to flood hazards through increased public awareness. There are many ways that community leaders can get both general and property specific information to citizens.

Public information activities in Gloucester County have been implemented through:

- a. Community Educational Outreach Projects
- b. Public Libraries and the County Website
- c. Technical Assistance and Map Information

5.4a Community Educational Outreach Projects

Community educational outreach projects are run by the county and meant to provide citizens with general flood hazard information. The projects encourage citizens to take an active role in educating themselves of their property's flood hazards so that they may take the necessary steps to protect themselves and their property from flooding.

What Has Been Implemented: Gloucester County Department of Community Education works with various County Offices that have been tasked with specific outreach projects in order to administer a comprehensive community information, education, and involvement program, which consists of:

- An informational telephone helpline, which is operational during hurricanes and other local emergency situations (Organized by the Department of Community

Education).

- An annual flood hazard awareness campaign throughout the community (Organized by the Department of Codes Compliance).
- The publication of informational brochures and fliers for special county meetings and forums related to flooding (Organized by the Department of Emergency Services).
- The development of the *Citizens Preparedness Guide* (a free seasonal hurricane preparedness guide that provides citizens with general information of the area's coastal flooding hazard, how to prepare for a hurricane, and what to do after a hurricane), (Organized by the Department of Emergency Services).
- The Community Emergency Response Team (CERT) program that educates citizens about disaster preparedness for hazards that may affect their area. It trains citizens in basic disaster response skills such as fire safety, search and rescue, team organization, and disaster medical operations. It also encourages its members to take an active role in their community by participating in emergency preparedness projects (Organized by the Department of Emergency Services).
- An annual hurricane preparedness exposition, which involves local radio stations, businesses (Wal-Mart, Lowes, and Home Depot), and county citizens. Each business is responsible for providing in-store displays with preparedness items and educational posters demonstrating techniques and materials that can retrofit a home to decrease or avoid flood damage (Organized by the Department of Emergency Services).
- Annual hazard awareness campaigns throughout the community, in relation to fires, hurricanes, and tornados (Organized by the Department of Emergency Services).
- Emergency information updates for severe weather and natural disasters (Organized by the Department of Emergency Services).

Recommendations for Improvement: The existing educational outreach programs effectively utilize outreach media to provide general flood safety and preparedness information to the public. The county should strengthen its program by specifically targeting property owners in flood zones with a specialized educational program that provides detail specific information relating to property protection, flood safety and flood insurance. The program should be aimed at educating and motivating the average property owner in the flood zone to investigate and implement property protection techniques. The program should highlight examples of property protection techniques that have been implemented in the local area (success stories). The program should identify and resolve common misunderstandings that many property owners in the flood zone may have. By providing specialized information to residents in the flood zone the county can help lower the amount of damage in the flood zone.

Recommendation 5.4a: The County should send an annual mass mailing (in the Beehive) with specialized information relating to property protection, flood safety and

flood insurance to owner in of property in a flood zone.

5.4b Public Libraries and the County Website

Public libraries and the Gloucester County website are key resources for both general and property specific information on flood hazard preparation and mitigation.

What Has Been Implemented: The public libraries in Gloucester County maintain an array of books on hurricanes, flood hazards, flood safety, and flood mitigation techniques. A search for “flood” and related topics in the Gloucester County Public Library’s catalog found four references that would be of use to property owners seeking information on flood mitigation techniques, additional titles provided general information on various types of natural disasters and historic flood information throughout the United States.

The county maintains an official website that gives citizens 24 hour access to the homepages of every department and service in the locality. The website has extensive hazard-related educational materials for citizens, including:

- Gloucester Connection Email News Service (A free county email news service which alerts citizens about emergency services and community education programs).
- Links to local travel alerts, weather, and tidal readings.
- Emergency preparedness information (online brochures and handouts).
- Emergency resource links for children and seniors.
- A link to Gloucester County Television Channel 48 (Local Government Channel).
- The *Citizens Preparedness Guide* (seasonal hurricane preparedness guide).
- The *Middle Peninsula Hazards Mitigation Plan* (describes all natural hazards in the area).

The County webpage also boasts an impressive web-based Geographic Information System (web-GIS), maintained by the Department of Information Technology/GIS. The web-GIS is a computer map-making application that allows anyone with computer access to obtain information on any property in the county. Notably, this application allows users to create detailed maps relating to hurricane surge, flood zones, topography, and aerial photography. These features enable the general public to take an active role in educating themselves about the flood risk in their area.

Recommendations for Improvement: Residents in Gloucester County need a central location where they can get all the information they need to prepare for flooding events caused by severe weather. One potential solution is for Gloucester County libraries to host a permanent educational flood preparedness display with printed educational material relating to flooding in the area. The display should have hard copies of all the material available online including county surge maps and flood zone maps, and the

Beehives' Citizens Preparedness Guide. Public flood hazard education sessions may also be held at the libraries. In addition, the library could pull all books related to flood preparedness from normal circulation and group them with the display as reference items not available for check-out, allowing residents to have continued access to these books.

Recommendation 5.4b: The County should adopt a central location where general information on flood preparedness, flood insurance, and floodplain management is easily accessible to the public in a hard copy format.

5.4c Technical Assistance and Map Information

Providing citizens easy access to property specific flood hazard information increases the community's overall awareness of potential flood hazards and may motivate property owners to take steps to mitigate their property against flood hazards. However, this information is useless if community members cannot understand its technical jargon or easily access it on-line. Therefore technical assistance opportunities are a vital part of disseminating property-specific information (St. Tammany Parish, 2004).

What Has Been Implemented: County residents in search of property specific flood hazard information can utilize the FEMA Flood Insurance Rate Map (FIRM), which are located in the Building Office at the Gloucester Courthouse area. For assistance interpreting the FIRM, citizens can contact staff in the Department of Codes Compliance. Citizens can rely on library resources and County officials in the Department of Codes Compliance as a starting point for ideas and suggestions on various retrofitting strategies specific to their property. Codes and Compliance staff visit properties in the community and offer pointers for improvements or suggest qualified contractors that can do the work.

Recommendations for Improvement: Gloucester County currently provides basic technical assistance for citizens seeking FIRM interpretations and retrofitting ideas, but there is little advertisement of these services. With proper advertisement, these services will be more extensively utilized by citizens seeking property-specific information, helping them to take steps to make their properties and the community more resistant to flood hazards.

Recommendation 5.4c: Gloucester County should advertise the technical assistance opportunities it provides in relation to flood mitigation and preparedness, preferably in the same central locations where other flood-hazard information is available, as suggested in Recommendation 5.4b.

5.5 Emergency Service Measures

Emergency service measures are designed to protect life and property in the event of a disaster or crisis situation. This plan is primarily interested in the emergency service measures which protect property.

Emergency service measures have helped strengthen the community's resistance to flood hazards through:

- a. Hazard Identification
- b. Warning

5.5a Hazard Identification

The local community relies on the Emergency Services Department and the National Weather Service to identify the time, location and severity of flooding in Gloucester County. Through advanced hazard identification emergency services can prepare citizens to take the appropriate actions to minimize the loss of property due to extreme conditions (St. Tammany Parish 2004, 7-12).

What Has Been Implemented: Hurricanes, tropical storms, and nor'easters are identified and tracked by the National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center in Miami, Florida. The Emergency Services Department then considers this information to determine how severely these weather patterns will affect the community. The Department utilizes local tide tables and a computer modeling program, SLOSH (Sea, Lake, and Overland Surges from Hurricanes), to run surge models based on information from the NOAA's National Hurricane Center.⁷ The models can help staff identify the areas of the county most affected by coastal flooding from specific storms. No improvement to Gloucester County's hazard identification process is needed.

Recommendation 5.5a: The County should continue to utilize its hazard identification process.

5.5b Warning

Once a possible flooding threat has been identified, the public must be warned. Proper precautions or evacuations can then be taken to prevent or decrease loss of life and property. Advanced warnings of oncoming seasonal coastal storms can provide residents with additional preparation time that may be utilized to install or properly prepare any last minute property protection measures.

What Has Been Implemented: The National Weather Service can issue either a Hurricane Watch (hurricane conditions within 36 hours), or a Hurricane Warning (sustained winds >74 mph expected within <24 hours) (NOAA: NWS). More specific warnings are communicated by Emergency Services staff. Gloucester County utilizes the Reverse 911 System (a mass telephone notification system) that allows Emergency Service staff to quickly contact citizens via home telephone to alert them of what they need to do to be safe in the event of an emergency. The telephone directory is updated bi-annually. In the event that the Reverse 911 System is down, Emergency Services can organize door-to-door emergency warning efforts to notify citizens. The local fire stations, Sheriff's Office, and a volunteer citizens group (CERT) provide the manpower to make this type of warning system possible, provided their number of available manpower allows for it. Bay Aging (a non profit organization that supports elderly citizens in the community) participates in door-to-door checks of elderly citizens and organizes a program to bring food to elderly citizens who choose to stay at home during evacuations.

⁷ Gloucester utilizes tidal readings from 3 tidal stations; the Yorktown United States Coast Guard (USCD) Training Center station (updated every 4 hours), the Sewell's Point station (updated every 8 hours), and the Chesapeake Bay Bridge tunnel station (updated every 8 hours). Notably Virginia Institute of Marine Science (VIMS) station on Oyster Point Pier provides "real time" readings (updated every six minutes).

Gloucester County participates in the Emergency Alert System (EAS). This system is a network of AM and FM radio and television stations that can be activated in case of an emergency. Local news stations are great resources before, after, and during a storm. They provide up-to-date information that, unlike the internet, is accessible to the majority of the public.

Recommendations for Improvement: The County's existing emergency warning system relies on home telephone, television, radio, email, and door-to-door service as its primary means to warn citizens of pending severe weather. However, for many citizens home telephone lines have become a thing of the past due to the decreasing costs of cellular phones and the increasing need to communicate on the go. The county can strengthen its reverse 911 system by including cellular telephone notifications in its system. By providing additional opportunities for citizens to receive early warnings of seasonal coastal storms citizens will have more time before the storm arrives, which can be used to implement any last minute protection measures to their homes.

Recommendation 5.5b1: The County should adopt a voluntary cellular telephone directory, which will work in unison with the existing reverse 911 system.

Recommendations for Improvement: The current warning system does not include Gloucester County residents who do not own or have access to home telephones, radios, or televisions. By adopting an outdoor emergency warning system based on sirens (with loud speaker capability) in areas of frequent congregation throughout the community, the county will be able to warn residents in high risk areas both pre and post emergency situations. Advanced warnings of oncoming seasonal coastal storms will provide residents with additional preparation time that may be utilized to install or properly prepare any last minute property protection measures, such as moving furniture or other valuables to higher elevations within the structure, or boarding up windows with plywood. After severe storms, high risk areas can remain without power or phone service for several days. The outdoor warning system can broadcast instructions to residents that have no access to telephone, radio, or television. The broadcast can direct returning residents to safer roads after a hurricane. This system can also be utilized in case of tornados, hail storms, terrorist attacks, and other emergency situations.

A set of criteria was followed to help determine where the outdoor warning system's sirens should be located. These were based on FEMA's "Outdoor Warning Systems Guide". The criteria used are as follows:

Priority 1: Locate sirens in the areas with most severe flood hazard.

Priority 2: Locate sirens in areas of frequent congregation.

Priority 3: Locate sirens in areas with the highest density of houses.

Priority 4: Relative location to other sirens (minimize overlapping of coverage area).

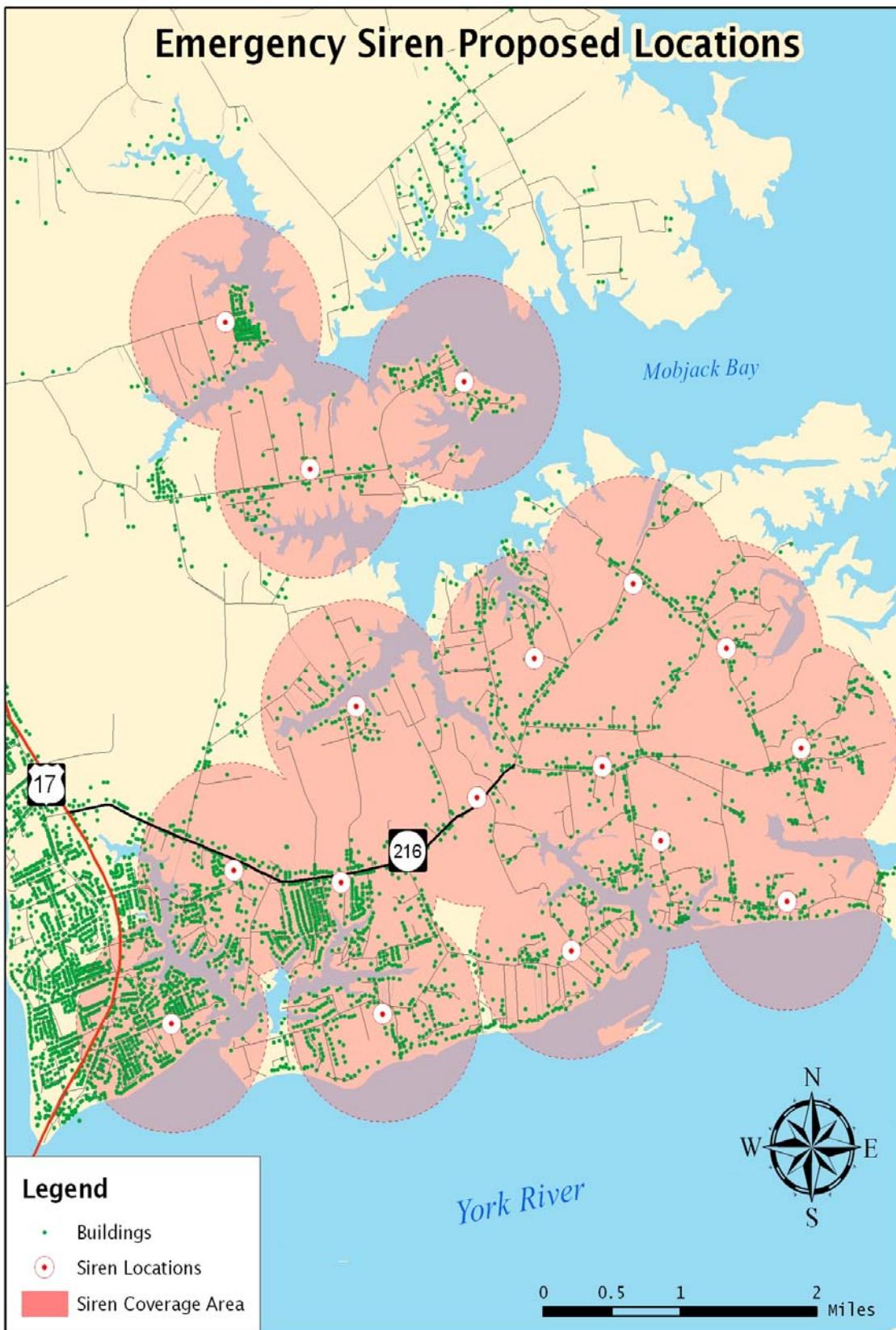
Modern sirens have clear omni-directional vocal broadcast capability within a range of up to 3,700 ft (FEMA 1980, 9). Gloucester County's outdoor emergency warning system should initially consist of 17 outdoor sirens located throughout the southeastern portion

of the county (Figure 27). These sirens should be placed throughout the highest density neighborhoods, as well as areas of frequent congregation.⁸ The system's control center should be housed, managed and maintained by the Emergency Services Department. The initial cost of the system would be based on the number of sirens put into place throughout the community. Based on the specifications of Acoustic Technology, Inc. and their HPSS32 siren, the estimated cost would be \$300,000 - \$400,000 (ATI Systems). Each additional siren would cost an extra \$20,000 (including installation). Initial funding for this system would come from FEMA Homeland Security grants.

Recommendation 5.5b2: Gloucester County should install an outdoor emergency warning system within the flood prone southeastern portion of the county.

⁸ It is when people are out shopping, in restaurants, at the barber shop, or in church, that they are away from home phones, radios, and televisions.

Figure 27



Source: County Base GIS layers were provided by United States Census Bureau and the County Addressed Building GIS layer was provided by Gloucester County Information Technology/ GIS Department.

5.6 Natural Resource Protection

Natural resource protection is a special type of mitigation activity that aims to preserve or restore natural areas through regulations. These regulations may indirectly benefit floodplain management activities in flood hazard areas (Des Plaines Engineering Department, 2002).

What Has Been Implemented: Gloucester County adopted the Chesapeake Bay Preservation Ordinance in 1991 as a response to the Chesapeake Bay Preservation Act (CBPA). The CBPA is a land use management program that aims to reduce sediment and pollution emptied into the bay through runoff from bordering lands. All of Gloucester County has been designated a Chesapeake Bay Preservation Area, due to its proximity to the Bay. The ordinance requires development in the county to meet certain performance standards that aim to minimize the type and the amount of runoff that goes into the bay. The ordinance designates areas of the county nearest the shoreline as Resource Protection Areas (RPA). The ordinance also designates Resource Management Areas (RMA) that buffer the RPA. The RMA is located landward and adjacent to the RPA, and includes areas with highly erodible soils, steep slopes, highly permeable soils, and non-tidal wetlands. These are land areas most prone to erosion, flooding, and groundwater contamination as a result of improper development (Gloucester County, 2005).

The ordinance requires a 100 foot buffer zone along all shorelines, which is mirrored by the Floodplain Management Ordinance in regards to VE zones in Gloucester County. The 100 foot buffer requirement acts to restore the natural functions of the floodplain and indirectly helps to minimize flood damage to new development along the coast, by forcing it to occur further from the shoreline and from potential wave action and tidal flooding.

The ordinance aims to improve environmental health by requiring the preservation of vegetation along the coast. The ordinance recommends that native vegetation should be retained wherever practical, and new plants should be introduced in locations that will be most affected by runoff. By mandating that vegetation be preserved along the coast the ordinance helps prevent erosion and sedimentation in case of a flood (FEMA, 1994). These buffers help to slow storm water runoff and protect against shoreline erosion. Other notable ordinances linked to the Chesapeake Bay Preservation Area Ordinance are the Erosion and Sediment Control Ordinance, which establishes requirements for the control of erosion and sedimentation in the county, and the Wetlands Zoning Ordinance, which regulates the use of wetlands within the county. The ordinance also requires any new development to provide a storm water maintenance agreement to the county.

Recommendation 5.6: The County should continue to enforce the Chesapeake Bay Preservation Ordinance, the Erosion and Sediment Control Ordinance, and the Wetland Zoning Ordinance.

Recommendation 5.6a: The County should develop a Storm Water Management Plan that will help regulate storm water throughout the county.

6. Action Plan

Chapter 2 defines the flood problem that the county faces. Chapter 3 analyzes the county's vulnerabilities. Chapter 4 sets two overall goals and four objectives for this plan and Chapter 5 describes existing mitigation strategies and recommendations for effectively achieving these goals. This chapter describes a plan of action for implementing the recommendations.

Goal 1: Protect public and private property from damage caused by coastal flooding hazard.

Objective 1.1: Prevent roadways in the County from being damaged during coastal flooding.

Recommendation 5.1b1 (Structural Improvement Activities): The County should utilize the road improvement priority list to prioritize the allocation of scarce resources to projects that support the largest number of unmitigated pre-FIRM structures in the SFHA.

Department Responsible: Planning and Emergency Services

[Tasks]

- 1) The Planning and Emergency Services Departments should coordinate with the VDOT Residency Office and the Board of Supervisors to allocate transportation funds towards road repair for prioritized roads (when funds become available).

Time Table: Ongoing

Budget Impacts: Minimal staff time

Recommendation 5.1b2 (Structural Improvement Activities): The County should continue to monitor State Route 649/ Maryus Road and if washouts from flooding persist the County should improve the road to withstand coastal floodwaters by elevating damaged sections and installing more appropriate roadway drainage crossings. This will help ensure emergency responders can gain access to 276 pre-FIRM structures built in the SFHA after a major coastal flooding event.

Department Responsible: Planning and Emergency Services

[Tasks]

- 1) Continue to monitor State Route 649/ Maryus Road during future storm events.
- 2) If needed the Planning and Emergency Services Departments should coordinate with the VDOT Residency Office and the Board of Supervisors to allocate transportation funds towards repairing Maryus Road to VDOT's current Secondary Road Standards.
- 3) VDOT should perform a road elevation and drainage study on the road to determine the specifics of needed improvements.

Time Table: Years 1 & 2

Budget Impacts: Minimal amount of staff time
Transportation Budget

Recommendation 5.1b3 (Structural Improvement Activities): The County should develop a semiannual ditch maintenance program for the southeastern portion of the

County. This will help residents in flood prone areas of the County safely utilize the roadways within their community during normal storm events as well as provide additional time for evacuation during the days before a coastal storm event.

Department Responsible: Planning and Emergency Services

[Tasks]

- 1) The Planning and Emergency Services Departments should coordinate with the VDOT Residency Office and the Board of Supervisors to determine how best to develop and fund a semiannual ditch maintenance program that meets VDOT standards and adequately addresses the concerns of citizens in the area.

Time Table: Years 1 & 2

Budget Impacts: Minimal amount of staff time
Transportation Budget

Recommendation 5.1b4 (Structural Improvement Activities): The County should keep detailed records of which roads in the county flood, how often and to what extent. This will help determine which additional roads in the county need to be considered for structural improvements and or other mitigation strategies.

Department Responsible: Emergency Services

[Tasks]

- 1) The Emergency Services Department should coordinate with the VDOT Residency Office to determine which roads in the county frequently flood and to what extent.

Time Table: Continuous, starting year 1

Budget Impacts: Minimal amount of staff time

Recommendation 5.1b5 (Structural Improvement Activities): The County should consider permanent road signage with gauges to mark high water on frequently flooded roads in the County. This will help make it safer for residents to gauge the depth of water on roadways before attempting to pass the road. These signs should be located on the lowest shoulders of the road and should be checked for proper functioning prior to a storm event.

Department Responsible: Emergency Services

[Tasks]

- 1) The Emergency Services Department should coordinate with the VDOT Residency Office and the Board of Supervisors to determine how best to locate and fund a high-water signage program that will meet VDOT standards and adequately addresses the concerns of citizens in the area.

Time Table: Years 1 & 2

Budget Impacts: Minimal amount of staff time
Transportation Budget

Objective 1.2: Protect new and existing development in the County's flood-prone areas from damages caused by coastal flooding.

Objective 1.3: Protect critical facilities from being damaged during coastal flooding.

Recommendation 5.2a: (Preventative Activities): The County should continue to zone for low density development and encourage residential clustering within flood-prone areas.

Recommendation 5.2b: (Preventative Activities): Gloucester County should continue to enforce building regulations throughout the county.

Recommendation 5.2c: (Preventative Activities): The County should continue to require and enforce the provisions of the Floodplain Management Ordinance.

Recommendation 5.3a (Property Protection Activities): The County should seek to acquire properties through a voluntary program according to the priority list in order to increase the amount of land preserved as open space, and to reduce the amount of flood damage to new and existing properties in the flood prone areas of the community

Department Responsible: Planning, Codes Compliance, and Emergency Services
[Tasks]

- 1) Adopt a priority acquisition list for repetitive loss properties
- 2) Send a letter to each property owner on the list to determine if they are interested in the voluntary program.

Time Table: Year 1

Budget Impacts: Minimal staff time

Recommendation 5.3b: (Property Protection Activities): The County should adopt this Floodplain Management Plan to help strengthen the community's mitigation activities as well as lower insurance premiums for policy holders.

Department Responsible: Department of Planning and Codes Compliance
[Tasks]

- 1) Bring the plan to the Planning Commission for review
- 2) Bring the plan to the Board or Supervisors
- 3) Revise the plan if necessary, hold a public hearing
- 4) Adopt the plan
- 5) Planning Committee Provides Annual Maintenance on the adopted plan

Time Table: Year 1

Budget Impacts: Minimal amount of staff time

Recommendation 5.6: (Natural Resource Protection Activities): Gloucester County should continue to require and enforce the Chesapeake Bay Preservation Ordinance, the Erosion and Sediment Control Ordinance, and the Wetland Zoning Ordinance.

Recommendation 3.4: (Safety & Health Hazards): The County should assist residents with existing fuel, oil and propane tanks that are not secured by providing tie-down assistance.

Department Responsible: Department of Codes Compliance and Emergency Services
[Tasks]

- 1) Identify properties with existing fuel tanks that are not tied down

2) Identify funding sources

Time Table: Year 1
Budget Impacts: Fair amount of staff time

Recommendation 3.4: (Safety & Health Hazards): The County should examine the public health, safety and economic impacts associated with the increased use of alternative septic systems in flood prone areas.

Department Responsible: Emergency Services, Virginia Department of Health, and the Board of Supervisors

[Tasks]

- 1) Identify impacts to the community
- 2) Develop policy which addresses these impacts

Time Table: Year 1 & 2
Budget Impacts: Large amount of staff time

Recommendation 2.4: (Climate Change): As more data become available the County should evaluate the potential impact of climate change on the community, particularly with respect to its wetlands, and consider potential management options.

Department Responsible: Emergency Services and the Board of Supervisors

[Tasks]

- 1) Identify impacts to the community
- 2) Develop policy which addresses these impacts

Time Table: Year 3
Budget Impacts: Large amount of staff time

Recommendation 5.6a: The County should develop a Storm Water Management Plan that will help regulate storm water throughout the county.

Department Responsible: Codes and Compliance and the Environmental Department

[Tasks]

- 1) Identify impacts to the community
- 2) Develop policy which addresses these impacts

Time Table: Year 3
Budget Impacts: Large amount of staff time

Recommendation 5.1a: (Structural Improvement Activities): The County should continue to implement the annual dam inspection and regular maintenance program, as well as continue to participate in the National Dam Safety Program.

Goal 2: Maximize citizen actions to protect private properties.

Objective 2.1: Ensure that residents are given adequate warning of potential coastal floods.

Recommendation 5.5a: (Natural Resource Protection Activities): The County should continue to utilize its hazard identification process.

Recommendation 5.5b1: (Emergency Service Measures): The County should adopt a voluntary cellular telephone directory, which will work in unison with the existing reverse 911 system.

Departments Responsible: Emergency Services

[Tasks]

- 1) Organize a voluntary cellular telephone number directory
- 2) Publicize the service (Local news paper and on the county website)
- 3) Update reverse 911 directories to include cellular telephone numbers

Time Table: Year 1

Budget Impacts: Minimal amount of staff time
Minimal advertising costs

Recommendation 5.5b2: (Emergency Service Measures): Gloucester County should install an outdoor emergency warning system within the flood prone southeastern portion of the county.

Departments Responsible: Emergency Services and Planning

[Tasks]

- 1) Apply for funding (Possible funding sources: FEMA's Homeland Security Grant Program, and its Pre-Disaster Mitigation Grant Program)
- 2) Initial contract bidding with various outdoor warning system companies
- 3) Installation of sirens
- 4) Train Emergency Service Staff to use the system
- 5) Advertise the warning system
- 6) Test the sirens

Time Table: Years 5

Budget Impacts: Extensive amount of staff time and resources
Costs of the system (estimated at \$300,000- \$400,000)
Minimal costs associated with training and advertising

Objective 2.2: Ensure that residents can easily obtain all general and property specific information relating to flooding and flooding risk.

Recommendation 5.4a (Public Information Activities): The County should send an annual mass mailing with specialized information relating to property protection, flood safety and flood insurance to every property owner in a flood zone.

Departments Responsible: Codes Compliance and Emergency Services

[Tasks]

- 1) Develop an informational news letter
- 2) Send the news letter to everyone in a flood zone

Time Table: Year 1

Budget Impacts: Initially this will consume large amounts of staff time and resources after the process is worked out staff time needed will decrease Minimal printing costs

Recommendation 5.4b: (Public Information Activities): The County should adopt a central location where general information on flood preparedness, flood insurance, and floodplain management is easily accessible to the public in a hard copy format.

Department Responsible: Emergency Services

[Tasks]

- 1) Determine an appropriate location, possibly the library.
- 2) Collect and inventory existing educational material from every department in the county.
- 3) Obtain additional copies of material from original source (as needed).
- 4) Develop additional educational material (as needed).
- 5) Install the educational material at appropriate location
- 6) Advertise the activity to residents (Local newspaper and on the County website)

Time Table: Year 1

Budget Impacts: Minimal amount of staff time
Costs to purchase additional educational materials
Costs to print additional educational materials
Minimal advertising costs

Recommendation 5.4c: (Public Information Activities): Gloucester County should advertise the technical assistance opportunities it provides in relation to flood mitigation and preparedness, preferably in the same central locations where other flood-hazard information is available, as suggested in Recommendation 5.4b.

A mass mailing that advertises the various technical assistance opportunities the county offers should be sent to every residence in the county. These services should continue to be advertised on the County's website.

Department Responsible: Codes Compliance

[Tasks]

- 1) Develop material that explains the technical assistance opportunities the County offers.
- 2) Send mass mailings

Time Table: Year 1

Budget Impacts: Initially this will consume large amounts of staff time and resources but after the process is worked out, staff time needed will decrease.

7. Plan Adoption

At the May 5, 2009 meeting of the Gloucester County Board of Supervisors the Board passed a resolution that authorized the Planning Department and the Department of Codes Compliance to move forward with the preparation of a Floodplain Management plan that meets FEMA CRS program requirements as well as establish a planning committee to annually evaluate and review the plan once adopted (see Appendix H).

A schedule for adoption of the plan is:

- Planning Commission Review
 - Public Hearing
 - Recommendation
- Board of Supervisors Review
 - Public Hearing
 - Adoption
- Annual Evaluation & Maintenance

8. Plan Maintenance

The following activities should be conducted following adoption by the BOS of this plan.

The monitoring, evaluating and updating of this plan shall be done on a yearly basis and shall be the responsibility of the Planning Committee that was charged with this task.

The first yearly evaluation of the adopted Floodplain Management Plan will be done after FEMA's final approval of the plan. For consistency purposes, the same evaluation tool will be used by the review planning committee to annually review the plan.

- 1) A written evaluation tool will be distributed approximately 1 month before the annual evaluation date for the plan.
- 2) The Review Planning Committee will solicit input for evaluation directly from residents in the community who have benefited from flood mitigation projects.
- 3) Convene meeting of the committee to go over evaluations
- 4) Develop goals and mini-strategies to be accomplished in the next year for the plan.
- 5) Provide FEMA/VDEM with a written evaluation report of progress/ obstacles/ opportunities in implementing mitigation strategies in the plan.
- 6) Identify possible future revisions to the plan and notify FEMA/VDEM in writing of the proposed revisions.
- 7) Provide follow-up assistance as requested by committee members with strategy implementation.

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Appendices

Appendix A: Flood Protection Questionnaire

Flood Protection Questionnaire

Gloucester County is in the process of preparing a floodplain management plan. When completed, the plan shall be used by County officials as a guide to assist in the planning and development of current and future development within flood zone districts of the County. This questionnaire is part of the planning effort. The questionnaire is anonymous and voluntary, but the more information the County has, the better. Information from the questionnaire will be used for internal planning purposes and will not be distributed.

Property Location: Bena Achilles Severn Maryus Jenkins Neck Perrin
 Other _____

1. Has your home or property ever been flooded or had a water problem? Yes No

If "yes," please complete this entire questionnaire.

If "no," please complete questions 6-9.

2. In what years did it flood? _____

3. Where did you get flood waters and how deep did it get?

- In yard only
- In crawl space under the house
- In basement
- Over first floor: _____ deep.
- Water was kept out of house by sandbagging.

4. What do you feel was the cause of your flooding? Check all that affect your building.

- Seasonal coastal storm events: hurricane, tropical storm, or nor'easter
- Unusually high tide
- Excessive rain which caused road gutter system to backup
- Standing water next to house
- Other _____

5. Have you ever installed any flood protection measures on your property?

- Elevation of home
- Flood proof home ex) used flood-resistant building materials
- Installed a pump system
- Moved things to higher levels within house (Second Floor or Attic)
- Backup power system/ generator
- Other _____

6. When did you move into the building? _____ When was your building built? _____

7. Do you have flood insurance?

8. Do you want information on protecting your house from flooding? ⁹

Source: Des Plaines Engineering Department, 2002

⁹ This form has been modified and adapted to Gloucester County from a pre-existing questionnaire used in preparing the Repetitive Loss Plan for Des Plaines Illinois.

Appendix B: Middle Peninsula District Committee Structural Vulnerability Study

		Vulnerability of addressed structures to category 2, 3, and 4 hurricanes in Gloucester County																					
		Block Grp 1 Cns Tret 1001	Block Grp 2, Cns Tret 1001	Block Grp 1, Cns Tret 1002	Block Grp 2, Cns Tret 1002	Block Grp 3, Cns Tret 1002	Block Grp 4, Cns Tret 1002	Block Grp 5, Cns Tret 1002	Block Grp 6, Cns Tret 1002	Block Grp 1, Cns Tret 1003	Block Grp 2, Cns Tret 1003	Block Grp 3, Cns Tret 1003	Block Grp 4, Cns Tret 1003	Block Grp 5, Cns Tret 1003	Block Grp 6, Cns Tret 1003	Block Grp 1, Cns Tret 1004	Block Grp 2, Cns Tret 1004	Block Grp 1, Cns Tact 1005	Block Grp 2, Cns Tact 1005	Block Grp 3, Cns Tact 1005	Block Grp 4, Cns Tact 1005		
																							Gloucester Totals:
Total Population: Census 2000	2421	4216	3133	1110	1021	1966	1681	2972	2777	1782	1509	1967	1673	1184	795	689	623	648	1642	971	Total Population: Census 2000		
Housing Units: Total	1026	1691	1243	582	474	703	753	1022	1055	652	616	869	740	578	430	306	311	311	746	386	Housing Units: Total	14494	
Total number of structures (based on E911 GIS data)	1171	1834	1438	615	484	789	837	1103	1147	693	618	656	658	565	467	387	336	315	715	432	Total number of structures (based on E911 GIS data)	15246	
Median value of owner-occupied housing from Census 2000	\$97,100	\$85,700	\$113,500	\$142,200	\$120,300	\$117,400	\$100,600	\$109,200	\$114,100	\$91,200	\$89,200	\$111,400	\$118,700	\$123,700	\$124,400	\$109,800	\$79,000	\$117,400	\$123,700	\$102,800	Median value of owner-occupied housing from Census 2000		
Number of structures potentially damaged by a Category 2 hurricane	37	126	72	339	73	0	0	1	41	20	19	67	13	135	377	265	336	315	715	432	Number of structures potentially damaged by a Category 2 hurricane	3443	
Potential property loss by a Category 2 hurricane	\$3,592,700	\$10,798,200	\$8,172,000	\$48,205,800	\$8,781,900	\$0	\$0	\$109,200	\$4,678,100	\$1,824,000	\$1,694,800	\$7,463,800	\$1,543,100	\$16,699,500	\$46,898,800	\$29,097,000	\$26,544,000	\$36,981,000	\$88,445,500	\$44,409,600	Potential property loss by a Category 2 hurricane	\$393,361,000	
Percent of Total Structures potentially damaged by a Category 2 hurricane	3.16%	6.87%	5.01%	55.12%	15.08%	0%	0%	.09%	3.57%	2.89%	3.07%	10.21%	1.98%	23.89%	80.73%	68.48%	100%	100%	100%	100%	Percent of Total Structures potentially damaged by a Category 2 hurricane	22.56%	
Number of structures potentially damaged by a Category 3 hurricane	106	162	112	502	101	0	0	8	100	24	19	82	23	213	389	295	336	315	715	432	Number of structures potentially damaged by a Category 3 hurricane	3994	
Potential property loss by a Category 3 hurricane	\$10,292,600	\$13,883,400	\$12,712,000	\$71,384,400	\$12,150,300	\$0	\$0	\$873,600	\$11,410,000	\$2,188,800	\$1,694,800	\$9,134,800	\$2,730,100	\$26,348,100	\$48,391,600	\$32,391,000	\$26,544,000	\$36,981,000	\$88,445,500	\$44,409,600	Potential property loss by a Category 3 hurricane	\$459,387,600	
Percent of Total Structures potentially damaged by a Category 3 hurricane	9.05%	8.83%	7.79%	81.63%	20.87%	0%	0%	.73%	8.72%	3.46%	3.07%	12.50%	3.50%	37.70%	83.30%	76.23%	100%	100%	100%	100%	Percent of Total Structures potentially damaged by a Category 3 hurricane	26.17%	
Number of structures potentially damaged by a Category 4 hurricane	137	223	154	550	144	0	1	25	189	51	47	110	68	332	401	304	336	315	715	432	Number of structures potentially damaged by a Category 4 hurricane	4594	
Potential property loss by a Category 4 hurricane	\$13,302,700	\$19,111,100	\$17,479,000	\$78,210,000	\$17,323,200	\$0	\$0	\$100,600	\$2,730,000	\$21,564,900	\$4,651,200	\$4,192,400	\$12,254,000	\$8,071,600	\$41,068,400	\$49,884,400	\$33,379,200	\$26,544,000	\$36,981,000	\$88,445,500	\$44,409,600	Potential property loss by a Category 4 hurricane	\$527,124,800
Percent of Total Structures potentially damaged by a Category 4 hurricane	11.70%	12.16%	10.71%	89.43%	29.75%	0%	.12%	2.27%	16.48%	7.36%	7.61%	16.77%	10.33%	58.76%	85.87%	78.55%	100%	100%	100%	100%	Percent of Total Structures potentially damaged by a Category 4 hurricane	30.10%	

Gloucester County

An analysis of estimated total pre-firm structure value by SFHA zones: A, AE, and VE for census tract-block groups.

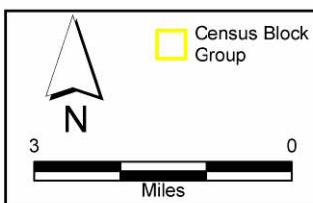
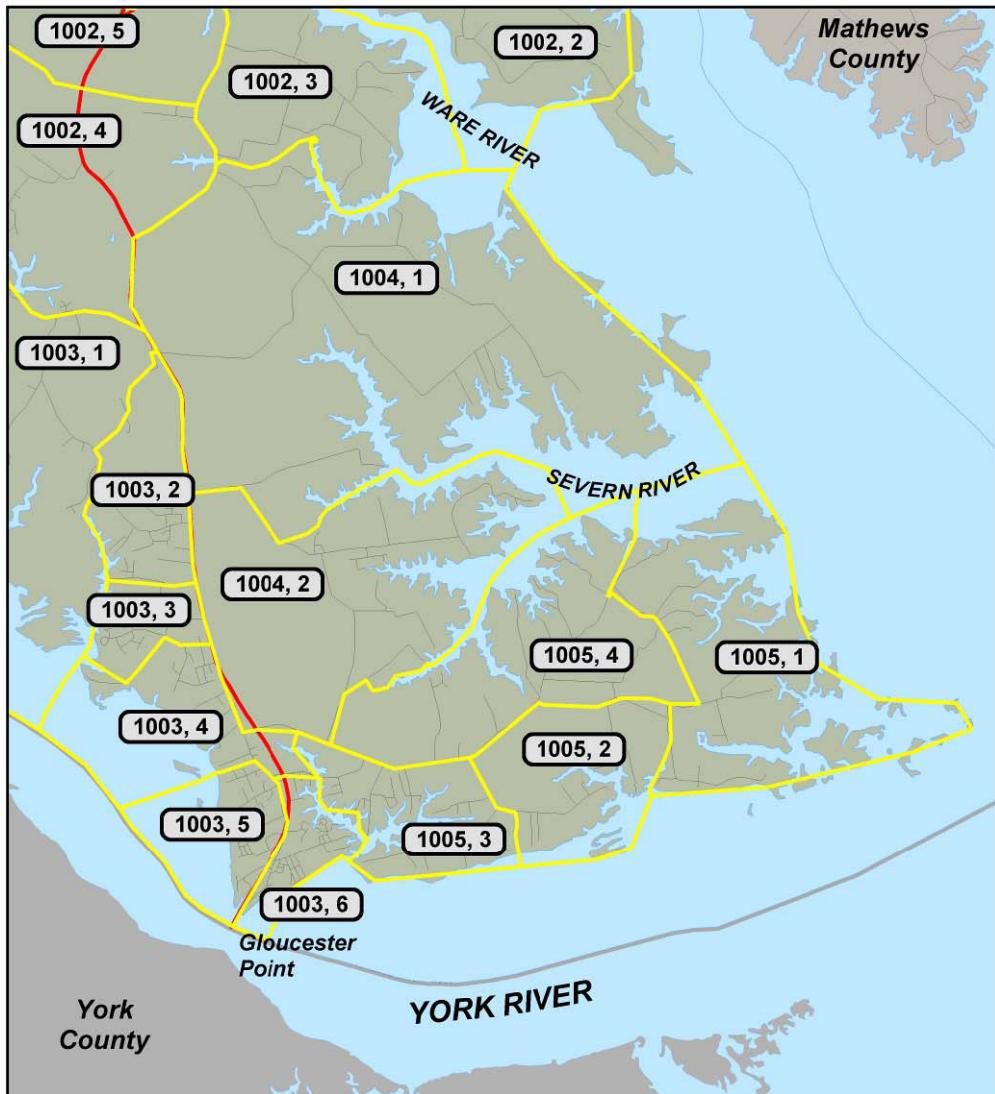
Flood Ordinance Adopted in Gloucester July 7, 1987

Geography	Block Group Code	Total population: Census 2000 (P001001)	Total number of structures (based on E911 GIS data)	Median value of owner-occupied housing (H085001)	% of Housing units 1989 or earlier	Housing Units 1989 or earlier	Total SFHA structures within the Special Flood Hazard Area	Total Pre-Firm Structures in SFHA	Total Value of Pre-Firm Structures in SFHA	Number of structures in Flood Zone A	Percent of Total	estimated pre-FIRM structures in Flood Zone A	estimated total value of pre-FIRM structures in Flood Zone A	Number of structures in Flood Zone AE	Percent of Total	estimated pre-FIRM structures in Flood Zone AE	estimated total value of pre-FIRM structures in Flood Zone AE	Number of structures in Flood Zone VE	Percent of Total	estimated pre-FIRM structures in Flood Zone VE	estimated total value of pre-FIRM structures in Flood Zone VE
Block Group 1, Census Tract 1001, Gloucester County, Virginia	1001, 1	2421	1171	\$87,100	62.67%	734	49	31	\$3,010,100	1	0.09%	1	\$97,100	47	4.01%	30	\$2,913,000	0	0.00%	0	\$0
Block Group 2, Census Tract 1001, Gloucester County, Virginia	1001, 2	4216	1834	\$85,700	72.03%	1321	97	71	\$6,084,700	1	0.05%	1	\$85,700	96	5.23%	70	\$5,999,000	0	0.00%	0	\$0
Block Group 1, Census Tract 1002, Gloucester County, Virginia	1002, 1	3133	1438	\$113,500	58.97%	848	90	54	\$6,129,000	5	0.35%	3	\$340,500	85	5.91%	51	\$5,788,500	0	0.00%	0	\$0
Block Group 2, Census Tract 1002, Gloucester County, Virginia	1002, 2	1110	615	\$142,200	93.64%	576	211	199	\$28,297,800	0	0.00%	0	\$0	196	31.87%	184	\$26,164,800	15	2.44%	15	\$2,133,000
Block Group 3, Census Tract 1002, Gloucester County, Virginia	1002, 3	1021	484	\$120,300	83.54%	404	71	60	\$7,218,000	0	0.00%	0	\$0	67	13.84%	58	\$6,736,800	4	0.83%	4	\$481,200
Block Group 4, Census Tract 1002, Gloucester County, Virginia	1002, 4	1966	789	\$117,400	81.51%	643	6	5	\$587,000	6	0.76%	5	\$587,000	0	0.00%	0	\$0	0	0.00%	0	\$0
Block Group 5, Census Tract 1002, Gloucester County, Virginia	1002, 5	1681	837	\$100,600	84.59%	708	7	7	\$704,200	6	0.72%	6	\$603,600	1	0.12%	1	\$100,600	0	0.00%	0	\$0
Block Group 6, Census Tract 1002, Gloucester County, Virginia	1002, 6	2972	1103	\$109,200	81.31%	897	10	9	\$982,800	0	0.00%	0	\$0	10	0.91%	9	\$982,800	0	0.00%	0	\$0
Block Group 1, Census Tract 1003, Gloucester County, Virginia	1003, 1	2777	1147	\$114,100	77.54%	889	60	47	\$5,362,700	0	0.00%	0	\$0	60	5.23%	47	\$5,262,700	0	0.00%	0	\$0
Block Group 2, Census Tract 1003, Gloucester County, Virginia	1003, 2	1782	693	\$91,200	76.84%	533	8	7	\$638,400	0	0.00%	0	\$0	8	1.15%	7	\$638,400	0	0.00%	0	\$0
Block Group 3, Census Tract 1003, Gloucester County, Virginia	1003, 3	1509	618	\$89,200	75.97%	470	6	5	\$446,000	0	0.00%	0	\$0	6	0.97%	5	\$446,000	0	0.00%	0	\$0
Block Group 4, Census Tract 1003, Gloucester County, Virginia	1003, 4	1967	656	\$111,400	90.22%	592	38	35	\$3,899,000	0	0.00%	0	\$0	38	5.79%	35	\$3,899,000	0	0.00%	0	\$0
Block Group 5, Census Tract 1003, Gloucester County, Virginia	1003, 5	1673	658	\$118,700	92.70%	610	10	10	\$1,187,000	0	0.00%	0	\$0	6	0.91%	6	\$712,200	4	0.61%	4	\$474,800
Block Group 6, Census Tract 1003, Gloucester County, Virginia	1003, 6	1184	566	\$123,700	85.99%	486	56	49	\$8,061,300	0	0.00%	0	\$0	52	9.20%	45	\$5,566,500	4	0.71%	4	\$494,800
Block Group 1, Census Tract 1004, Gloucester County, Virginia	1004, 1	795	467	\$124,400	75.12%	351	237	179	\$22,267,800	0	0.00%	0	\$0	223	47.75%	168	\$20,899,200	14	3.00%	11	\$1,368,400
Block Group 2, Census Tract 1004, Gloucester County, Virginia	1004, 2	689	387	\$109,800	96.41%	373	216	209	\$22,948,200	0	0.00%	0	\$0	180	46.51%	174	\$19,105,200	36	9.30%	35	\$3,843,000
Block Group 1, Census Tract 1005, Gloucester County, Virginia	1005, 1	623	336	\$79,000	95.50%	321	335	321	\$25,359,000	0	0.00%	0	\$0	211	62.80%	202	\$15,968,000	124	36.90%	119	\$9,401,000
Block Group 2, Census Tract 1005, Gloucester County, Virginia	1005, 2	648	315	\$117,400	89.39%	282	228	205	\$24,067,000	0	0.00%	0	\$0	204	64.76%	183	\$21,484,200	24	7.62%	22	\$2,582,800
Block Group 3, Census Tract 1005, Gloucester County, Virginia	1005, 3	1642	715	\$123,700	90.21%	645	173	157	\$19,420,900	0	0.00%	0	\$0	173	24.20%	157	\$19,420,900	0	0.00%	0	\$0
Block Group 4, Census Tract 1005, Gloucester County, Virginia	1005, 4	971	432	\$102,800	88.86%	384	326	290	\$29,812,000	0	0.00%	0	\$0	324	75.00%	288	\$29,806,400	2	0.46%	2	\$205,600

Gloucester totals: 15260 82.65% 12065 2233 1950 \$214,482,700 19 0.12% 16 \$1,713,900 1987 13.02% 1718 \$191,784,200 227 1.49% 216 \$20,984,600

Total Number of Structures 15,260
% of Housing Units Pre-1989 82.65%
Housing Units Pre-1989 12,065
Total Pre-Firm Structures in SFHA 1,950
Total Value of Pre-Firm Structures in SFHA \$ 214,482,700

Southeast Gloucester County Census Groups (Tract #, Blockgroup #)



Source: Middle Peninsula Planning District Commission, 2005

Appendix C: VDOT Elevation Study on Select Roads in Gloucester County VA

TO: Christopher Perez
FROM: VDOT Central Office (Richmond VA) Engineering Staff
DATE: April 20, 2007

Anticipated Flood Tide Levels for the Roadways in Gloucester County's Southeastern Portion

This report is an investigation of the anticipated flood tide levels for the southeastern portion of the county's roadways (plus the Rte. 17, north approach to the Coleman Bridge). Everything was based on the FEMA Flood Insurance Study (FIS) for Gloucester County (dated August 4, 1987) and available Flood Insurance Rate Map (FIRM).

VDOT's usual criteria for protection of its roadway facilities against flooding is to have the lowest edge of shoulder elevation of the roadway prism 18" minimum above the prescribed level of flood protection. The prescribed level of protection usually would be as follows: 10-yr. for secondaries and 25-yr. for primaries and arterials.

The elevations cited in this report are based on the above. Tidal flooding in the southeastern portion of the county can take the form of either essentially stillwater or stillwater plus wave action, depending on how close the area in question is to open water. Inland areas are typically only subject to stillwater tidal action, whereas exposed areas (in this case those areas closer to the York River and/or the Bay) are also subject to wave action (in which case anticipated wave crests are added to the stillwater tide levels). FEMA, with their FIRM maps, identifies those areas of stillwater only (Zone AE designations) as well as those areas subject to wave action (Zone VE designations). Some of the roadways investigated had segments that fell in both zones and therefore different recommended elevations have been shown. The stillwater elevations for Gloucester County as shown in the FIS book were as follows:

<u>FLOOD FREQUENCY (YRS.)</u>	<u>FLOOD ELEVATION (FT.)*</u>
10	5.0
25**	5.8**
50	6.5
100	7.3

* Based on North American Vertical Datum of 1922 (NGVD '29 datum)

** Mathematical interpolations of these values, as the FIS book didn't show them.

The wave crests that can be experienced in open areas can raise the above values up to 3 additional ft. It should be noted that wave crest values were only provided for the 100-yr. flood event but, for the purposes of this report, the report assumed that the same wave crests would also apply to a 10 and 25-yr. event where applicable. This is probably conservative but should be satisfactory for estimating purposes.

Below is the report which deals with each individual roadway and is predicated on the above.

George Washington Memorial Highway (Rte. 17)

Because this is considered to be an emergency/ hurricane evacuation route, the roadway should be above a 100-yr. flood tide. If the roadway is not above a 100 yr flood tide, then in order to get the roadway above a 100-yr. flood tide level, the lowest approaches to the Coleman Bridge will need to be raised such that the lowest shoulder will be at or above elevation 12.5.

Maryus Road (Rte. 649)

To ensure the roadway is above a 10-yr. flood tide level the reach from the intersection with Rte. 648 eastwards to the end of state maintenance will need to be raised such that the lowest shoulder will be at or above elevation 9. For the intersection of Rte. 653 eastwards to the intersection of Rte. 648 to be above a 10 yr flood tide level the section will need to be raised such that the lowest shoulder will be at or above elevation 7.

Greate Road (Rte. 1208)

To get the roadway above a 10-yr. flood tide level that portion of the roadway in close proximity to the York River will need to be raised such that the lowest shoulder will be at or above elevation 9.

Guinea Road (Rte. 216)

To get the roadway above a 25-yr. flood tide level the entire roadway grade from its intersection with Rte. 17 eastwards to its intersection with Rte. 649 & 653 will need to be raised such that the lowest shoulder elevation will be at or above elevation 8.

Mark Pine Road (Rte. 643)

Nearly the entire length of the roadway will have to be raised such that the lowest shoulder elevation is at or above elevation 7.

Little England Road (Rte. 642)

To get the roadway above a 10-yr. flood tide level that portion of the roadway nearest the York River (the western end) will need to be raised such that the lowest shoulder will be at or above elevation 7.

Cuba road (Rte. 643)

The Easternmost end of the roadway will have to be raised such that the lowest shoulder will be at or above elevation 7. Just to the west, where the roadway makes a sharp bend to the northeast, it will have to be raised such that the lowest shoulder will be at or above elevation 7. Further west at Cuba Road's intersection with Rte. 642 the roadway will have to be raised such that the lowest shoulder will be at or above elevation 7.

Kings Creek Road (Rte. 653)

To get the roadway above a 10-yr. flood tide level, the following will need to be done. The roadway from the intersection with Rte. 652 northeastwards to the end of state maintenance will need to have the entire grade raised such that the edge of the lowest shoulder elevation will be at or above elevation 9. From the intersection with Rte. 652 southwestwards to the intersection of Rte. 649, the entire grade will need to be raised such that the lowest shoulder elevation will be at or above elevation 7.

Appendix D: Saffir-Simpson Hurricane Damage Scale

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region. Note that all winds are using the U.S. 1-minute average.

<u>Hurricane Category</u>	<u>Sustained Winds (mph)</u>	<u>Storm Surge</u>	<u>Damage Potential</u>
Tropical Storm	> 40 mph		
1	74 – 95	4 – 5 ft	Minimal
2	96 – 110	6 – 8 ft	Moderate
3	111 - 130	9 – 12 ft	Extensive
4	131 - 155	13 - 18 ft	Extreme
5	> 155	> 18 +	Catastrophic

Category 1

A Category 1 hurricane has storm surges 4-5 feet above normal. It poses little to no damage to building structures and minimal damage to unanchored mobile homes, shrubbery, and trees. There may be minor pier damage and coastal road flooding.

Category 2

A Category 2 hurricane has storm surges 6-8 feet above normal. It poses considerable damage to mobile homes, piers, signs, shrubbery, and tress. Damages to building structures include roof damage, doors and windows. Notable impacts include coastal and low lying areas flood 2 - 4 hours before arrival of the hurricane in.

Category 3

A Category 3 hurricane has storm surges 9-12 feet above normal. There will be structural damage to small residences and utility buildings. Extreme damage to mobile homes, trees, and shrubbery. Notable impacts include flooding of low lying areas 3-5 hours before the arrival of the hurricane. Coastal flooding has a high potential to destroy small building structures as well as significantly damage larger structures through debris from floating debris. Land that is lower than 5 feet above mean sea level can be flooded 8 or more miles inland.

Category 4

A Category 4 hurricane has storm surges 13-18 feet above normal. These storms have extreme damage potential. Building structures may experience extensive curtain-wall failures with extensive damage to roofs, doors and windows of small residences. Major damage will occur to lower floors of structures near the shore. Terrain lower than 10 feet above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles. Complete destruction of mobile homes, as well as major damage to shrubs, trees, and all signs. Notable impacts include flooding of low lying areas 3-5 hours before arrival of the hurricane.

Category 5

A Category 5 hurricane has storm surges 18 feet above normal. These storms have catastrophic damage potential. Complete roof failure of many residences and industrial buildings. Severe and extensive window and door damage is expected. Some complete building failures with small utility buildings may be blown over or away. All shrubs, trees, and signs will be blown down. Complete destruction of mobile homes. Low-lying areas are flooded 3-5 hours before arrival of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles of the shoreline may be required.

Source: NOAA National Hurricane Center

Appendix E: Gloucester County Growth Rate

Gloucester County Growth Rate								
Population						Percent Change		Percent Change
1980	1990	2000	2010	2020	2030	1980-1990	1990-2000	Average
20,107	30,131	34,780	38,900	42,700	46,199	49.90%	15.40%	32.60%

Source: United States Census Bureau, 2000

Appendix F: VDOT Road Closure Data for Gloucester County (1999 – 2006)

TO: Christopher Perez
FROM: VDOT Staff
DATE: April 2, 2007

Road Closures in Gloucester, VA: Hurricane Floyd 9/18/1999		
<u>Route</u>	<u>From</u>	<u>To</u>
36		
605		
606		
610		
612		
614 (at Mill Pond)		
614 (at Petworth Church Rd)		
616		
629 (at Rt. 728)		
637 (end of state maintenance)		
1246 (end of state maintenance)		

Road Closures in Gloucester, VA: Hurricane Isabel 9/18/2003		
<u>Route</u>	<u>From</u>	<u>To</u>
601		
602		
605		
606		
608		
609		
610		
611		
617		
621		
625		
628		
630		
631		
633		
635		
648		
678		

Road Closures in Gloucester, VA: Hurricane Ernesto 9/1/2006		
<u>Route</u>	<u>From</u>	<u>To</u>
198	Rt. 17	Rt. 610
606		
614		
662		
666		
Great Rd		
Maryus Rd		

Road Closures in Gloucester, VA: Severe Storm 10/7/2006		
<u>Route</u>	<u>From</u>	<u>To</u>
662	at bridge	
1208	at boat landing	

Road Closures in Gloucester, VA: Severe Storm 11/17/2006		
<u>Route</u>	<u>From</u>	<u>To</u>
611		
614		
625	at Rt 623	
662		
701		
1208		

Appendix G: Documentation of the Planning Process

Planning Committee Members

- 1) Paul Koll: Gloucester County Building Official
- 2) Christopher Perez: Gloucester County Planner and then Graduate student in the Masters of Urban Regional Planning (MURP) Program at Virginia Commonwealth University (VCU)
- 3) Anne Ducey-Ortiz, Gloucester County Director of Planning
- 4) Jay Scudder: former Director of Planning
- 5) Mark Westfall: former Emergency Management Coordinator
- 6) Dr. Mort Gulak: Professor of Urban Studies and Planning, L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University (VCU)
- 7) Dr. Avrum J. Shriar: Professor of Urban Studies and Planning, L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University (VCU)

Time Table of Events during the Planning Process

While these meetings are not the entire sum of planning efforts during the development of the Floodplain Management Plan, they represent a comprehensive outline of the steps throughout the process.

January 25, 2007 @ 3:30pm

Held an initial meeting between all Floodplain Management Plan planning committee members to discuss the role of the committee in the formation of the plan, follow up committee meetings to discuss the plans' progress, the perimeters of the plan, the various agencies that needed to be involved, the necessity for public involvement, various resources to aid in the risk assessment of the area, as well as the time frame for the plans completion and projected adoption date.

May 10, 2007 @ 7pm

Community meeting at Achilles Elementary School to gain citizen involvement and community awareness (Below is a cutout of the meeting advertisement).

Full

THURSDAY MAY 10, 2007

Gloucester-Mathews Gazette Journal

Facing flooding

Session tonight at
Achilles School

BY BILL NACHMAN

Gloucester County will sponsor a public information meeting at 7 tonight at Achilles Elementary School to discuss various community concerns related to coastal flooding problems in the county, specifically the Guinea area.

The purpose of the meeting will be to engage with the public and field any questions or concerns that residents might have relating to Gloucester's flooding problem, said planning director Jay Scudder.

The meeting will assist Gloucester's planning staff as it formulates future coastal flooding mitigation strategies, Scudder said.

The meeting is not being

SEE ACHILLES, PAGE 21A

ACHILLES: Meeting to-night on flood problems

(CONTINUED FROM PAGE 1A)

held to apply for a grant, is not related to several unrelated meetings held earlier that concerned specific grant projects linked to hazard mitigation and elevation programs.

A brochure that will be distributed notes that "the floodplain contains Gloucester County's valuable natural resources including wetlands, beaches, forests, rivers, streams and the plant and animal communities that inhabit them." Also, the brochure said that "highlights of the county are vast salt marshes and expansive rivers and creeks. These natural resources are unique to the Chesapeake Bay region and are important to Gloucester County's environment and economic welfare."

Codes compliance director Ron Peaks said the county has adopted a number of programs to help preserve and protect these valuable resource areas, including

Chesapeake Bay Preservation, Erosion and Sediment Control, Wetlands Protection, and Floodplain Management. Holding the meeting will "help get the public involved" in the county's floodplain management efforts, he said.

Building official Paul Koll said Gloucester is under a Community Rating System program for flood insurance purposes. If the county improves its floodplain management program, residents might qualify for additional flood insurance discounts under the National Flood Insurance Program, he said.

Chris Perez, a student at Virginia Commonwealth University, is examining the local floodplain as part of a collegiate program. He is scheduled to hear comments from residents about how they are impacted by present flood control measures and suggestions for improvements at tonight's meeting. For more information, call 693-1224.

Source: Gloucester-Mathews Gazette Journal

POINT PANORAMA



Coastal flooding topic of sparsely attended info meet at Achilles

BY BILL NACHMAN

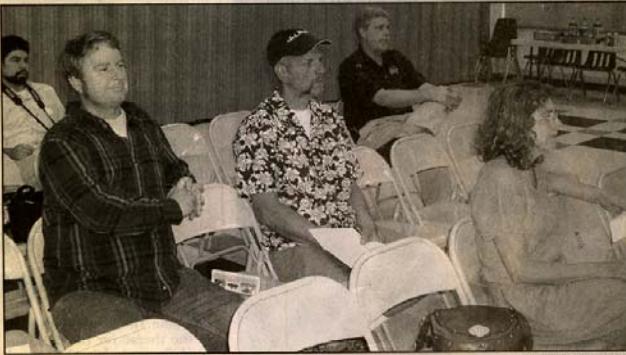
Gloucester County sponsored a public information meeting May 10 to discuss various community concerns related to coastal flooding problems in the county, specifically the Guinea area.

The purpose of the meeting, held at Achilles Elementary School, was to engage with the public and field questions that residents might have relating to the county's flooding problem, said planning director Jay Scudder. Also, Scudder said the meeting will assist Gloucester's planning staff in formulating possible future coastal flooding mitigation strategies in the county.

Scudder said that the staff picked up some good ideas from residents about steps to take before flooding occurs. Only about a dozen persons attended the meeting.

For example, one person suggested the county install alarms in the Guinea area, possibly on low-lying Guinea Circle, to alert citizens that they are in danger of flooding or other severe weather and should quickly leave the area before the roadway becomes impassable.

Another suggestion was to ask the Virginia Department of Transportation for better cleaning of ditches in that area. One woman said that her husband has tried to dig out some of their ditch, but she



BILL NACHMAN / GAZETTE-JOURNAL

Only about 10 people attended a public meeting about floodplain management Thursday night at Achilles Elementary School. Suggestions aired included placing alarms in the lower county to notify residents of threatening storms, cleaning ditches, and improving low-lying roads.

believes that VDOT should be doing that job.

County officials said they are trying to establish better communications with residents. But one man said putting out e-mails won't be effective since many people in the lower county don't have computers.

Emergency services director Mark Westfall said that county officials usually have ample time to alert residents about impending storms—but that's not always the case. "Ernesto was one of those anomalies," Westfall said of the Sept.

1, 2006 tropical storm that caused more extensive damage than had been predicted.

Building official Paul Koll said that many county roads are low and officials need to address ways these might be improved to allow residents safer evacuation.

Chris Perez, a alumni of Gloucester High School who is now a graduate planning student at Virginia Commonwealth University, is studying the local floodplain management as part of his graduate research. "We're in a pretty weather-prone area," Perez

said of Gloucester.

In too many cases local properties suffer "repetitive losses," with insurance and grants being used to repair damaged properties, Perez said. Elevation grants are being offered to elevate some flood-prone properties above the flood stage.

Koll said subsequent public meetings might be held as the county studies its flood management options. Also, he said that Gloucester is under a Community Rating System program for flood insurance purposes. If the county improves its floodplain management program, he said, residents here might qualify for additional flood insurance discounts under the National Flood Insurance Program.

For more information about floodplain management in Gloucester, call the Gloucester Planning office at 693-1224.

Source: Gloucester-Matthews Gazette Journal

May 2007

Formulated Draft Goals and Objectives for Floodplain Management Plan

August 2007

Provided a working draft of the Floodplain Management Plan, which Committee Members edited and strengthened through numerous meetings and editing sessions.

Oct 23, 2007 @ 7pm

Follow up Community Meeting at Achilles Elementary School to gain citizen involvement and community awareness (Below is a cutout of the meeting advertisement).

Meeting at Achilles to focus on coastal flooding

Gloucester County will sponsor a public information meeting Oct. 23, beginning at 7 p.m. at Achilles Elementary School to discuss community concerns related to coastal flooding problems in the county, specifically, the Guinea area. A follow-up meeting to one held earlier this year, it will provide the public with information on the importance of planning when living in flood-prone areas, according to a release from Gloucester's Department of Community Education.

Additionally, information will be gathered from participants on specific ideas and information from their experiences with coastal flooding. The meeting is not associated or related with FEMA grant funding, the release said. It is intended to provide Gloucester County's Planning Department staff with future coastal flood mitigation strategies.

For more information, please contact the Gloucester Planning Department at 693-1224.

\$20 off on all service contracts through Oct. 31st with this ad
GLOUCESTER • 804-684-0808 • 4041 Geo. Wash. Mem. Hwy., Hayes
WILLIAMSBURG • 757-221-0928 NEWPORT NEWS • 757-930-0928

Source: Gloucester-Mathews Gazette Journal

November 19, 2007

Planner, Christopher Perez met individually with each committee member to discuss the current draft of the plan and provide any comments or suggestions.

December 13, 2007

Dissertation meeting at VCU to formally present the Plan to the VCU Master of Urban and Regional Planning Program.

February 22, 2008

Floodplain Management Plan sent to the ISO review board.

April 18, 2008

ISO 510 review received.

April 3, 2008 @ 7:30pm

Floodplain Management Plan Presentation to the Planning Commission (below is the minutes from the meeting).

**AT A MEETING OF THE GLOUCESTER COUNTY PLANNING COMMISSION
HELD THURSDAY, APRIL 3, 2008 IN THE COLONIAL COURTHOUSE, 6504
MAIN STREET, GLOUCESTER, VIRGINIA**

THERE WERE PRESENT:

Thomas Arnold

Kenneth Richardson

William Rodgers

Michelle Ressler

Michael Winebarger

Natalie Johnson

Hal McVey III

Keith Belvin, Vice Chairman

Wyvonna Carter

THERE BEING ABSENT:

Eric Weisel

Phillip Bazzani, Chairman

Laurence Wilkinson

Mark Strawn

ALSO IN ATTENDANCE:

Jay Scudder, Director of Planning

Anne Ducey-Ortiz, Planner III

Christopher Perez, Planner I

IN RE: MEETING CONVENED

Keith Belvin, Vice Chairman, called the April 3, 2008 meeting of the Gloucester County Planning Commission to order at 7:30 P.M. Roll call established a quorum was present.

IN RE: CONSENT AGENDA

The Consent Agenda consists of 1) Minutes of February 19, 2008 Meeting; 2) Minutes of March 6, 2008 Meeting; 3) Application(s) before the BZA in April; 4) Housing Report – February 2008

Mr. Winebarger stated that he had a correction for the March 6, 2008 meeting minutes. He noted that a statement made by Mr. Rodgers right before adjournment was not put in the minutes and he would like it added, verbatim. The statement is as follows:

“Actually what Eric said, and all, is right, in fact, we’ve written into our rules of procedures, we did not follow it tonight with the first subdivision, we did do it the last

meeting before we started on Bedford Falls and that is to make the statement that we are strictly looking, to look at it, to be sure it passes, everything in the ordinance. If we can make recommendations, and we've gotten some things by having these reviews, we've gotten some things fixed in developments that although they met the ordinance completely, but a little extras, by having it in here and I think that's good, I think we need to have it in there, also gives us an opportunity to see what's going on and see where we need to change the ordinance."

A motion to accept the Consent Agenda with changes was made by Mr. Rodgers, seconded by Ms. Ressler and carried by a unanimous voice vote.

IN RE: PUBLIC COMMENT

There being no concerns or comments expressed by the public, the Vice Chairman closed the floor to public comment.

IN RE: NEW BUSINESS

A. Floodplain Management Plan

Mr. Perez gave a power point presentation:

Gloucester County Floodplain Management Plan

Background –

- In 1987, Gloucester County became a participating community in FEMA's National Flood Insurance Program (NFIP) which enables property owners to obtain federally backed flood insurance.
- Shortly after the County joined the Community Rating System (CRS) program.

The program modifies annual premiums based on the participating community's efforts to reduce future flood damage in the area.

- In 1994, Gloucester County earned a Class 9 status in the Community Rating System (CRS) program.
5% off annual premiums.
- There are approximately 1,415 flood insurance policy holder's within the County.
- To gain further reductions in flood insurance policy premiums (up to 15%) the county must gain credits that will qualify the locality at a lower CRS rating.

One method of acquiring CRS credit is through the development of a floodplain management plan for the county.

What is a Floodplain Management Plan?

A Floodplain Management Plan analyzes the causes of coastal flooding in the County and identifies the vulnerabilities within the community.

The plan also documents and analyzes the County's existing coastal flood management practices and provides feasible solutions to strengthen the overall coastal flood management system, intending to lessen the amount of damage caused by coastal flooding.

Note: It is not the purpose or the intent of this plan to commit the county to large public expenditures.

Vulnerabilities within the Community

- Potential Property Damage from Storm Surge
- Repetitive Loss Areas
- Vulnerable Populations
 - Age, Disability, and Income Levels
- Critical Facilities
 - Police Station, Fire and Rescue, Government Buildings, Schools and Shelters, Hospitals, Utilities, and Roads,
- Safety and Health Hazards

Mitigation Strategies

- 1) **Structural Improvement Activities** – Road Improvements
 - Reservoir protection
 - Planning and Zoning
 - Building Regulations
 - Flood Development Regulations.
- 2) **Preventative Measures**
 - Acquisition and elevation of property
 - Purchasing flood insurance
 - Community Educational Outreach Programs
 - Public Libraries and the County Website
 - Technical Assistance
- 3) **Property Protection Measures**
 - Hazard Identification, Warning, Response, and Recovery Efforts.
- 4) **Public Information Measures**
- 5) **Emergency Services Measures**
- 6) **Natural Resource Protection Measures** – a special type of mitigation activity that aims at preserving or restoring natural areas.

Where are we?

The Initial Draft of the Floodplain Management Plan
ISO review board *
Comprehensive Plan Steering Committee
Planning Commission
Board of Supervisors

End of Presentation

Mr. Winebarger asked who the ISO review board was.

Mr. Richardson stated the Insurance Services Organization, the same group that rates fire departments.

Ms. Johnson asked what this really does once it is adopted, does it require the county or the citizens to do anything?

Mr. Perez stated that it does not officially require the county to do anything. He stated that the plan tells us what our weaknesses are in the county, why we are having flooding issues, who is vulnerable, and what we are currently doing and how we could make that stronger.

Mr. Scudder stated that with the FEMA programs the county has probably received within the range of 3.6 million dollars, through the Hazard Mitigation Program. He noted that there is a Pre-Hazard Mitigation Program that is an allocation of money each year, and jurisdictions that choose to participate can take advantage of those programs. He stated that Gloucester County has been participating in both of those programs for years. He stated that the direct benefit of the citizens from this Floodplain Management Plan is to get a higher rating from CRS which will reduce flood insurance premiums for the residents.

Mr. Rodgers asked if just having the plan in place actually improves our rating from a 9 to something like an 8 or a 7.

Mr. Scudder stated that just having to plan and meeting the objectives reduces the insurance premium.

Mr. Winebarger asked how far in the 1-10 scale will Gloucester County have to move to increase or savings from the current 5%.

Mr. Richardson stated that from what he has seen there is no real guidelines to determine what you get for different things you do.

Dr. Belvin suggested to Mr. Perez that after the ISO review board has approved this document, it be forwarded to the Planning Commission.

IN RE: ADJOURNMENT

July 2008 –May 2009

Collect, organize, and edit the draft Floodplain Management Plan, in preparation to have the Board of Supervisors review the plan and ultimately adopt it.

May 14, 2009 @ 7pm

The third follow up Community Meeting at Achilles Elementary School was held to review the draft floodplain management plan and gain citizen input (Below is a cutout of follow-up article of the meeting in the Gloucester-Mathews Gazette Journal).

ANORAMA

THURSDAY MAY 28, 2009

Perez said another electronic means of warning residents who might be affected by hurricanes, tornadoes and other storm events would be to set up a voluntary cell phone Reverse 911 alert system.

Several persons said they think the Virginia Department of Transportation should become much more involved in maintaining ditches in lower Gloucester, cleaning them on a more regular basis and especially removing debris and making needed culvert repairs prior to a hurricane hitting the area.

One person suggested using trustees from the Gloucester jail to clean ditches or to have local residents volunteer to clean them. However, codes compliance director Ron Peaks said that there might be a liability issue of using sheriff's trustees on private property and neither they nor well-meaning volunteers would have the necessary heavy equipment needed for proper cleaning.

Perez said that some of the high-priority roads in terms of readying them for storms include Maryus Road, Ditchley Road, Almondsville Road, and Featherbed Lane.

Besides public comments, the draft plan will include comments from a variety of agencies such as Gloucester and Abingdon Volunteer Fire and Rescue squads, Gloucester Sheriff's Office, Virginia Department of Transportation, Middle Peninsula Planning District Commission, and others.

Perez and Koll said they expect the Gloucester Planning Commission to schedule a hearing on the draft plan this summer and the Gloucester Board of Supervisors may hold its own hearing on the matter in the fall.

For more information about the draft plan, call Perez at 693-1224 or Koll at 693-2744 or visit the Gloucester County website at www.glmva.info/planning.

Comments taken on flood management

BY BILL NACHMAN

The Gloucester County Departments of Planning and Codes Compliance sponsored a public meeting May 14 at Achilles Elementary School to discuss the recommendations presented in the draft Floodplain Management Plan.

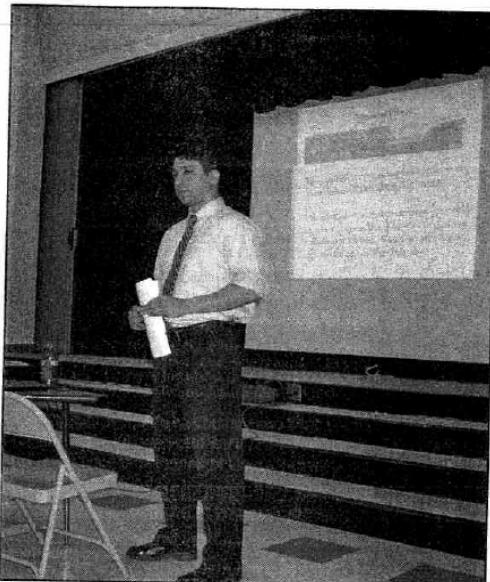
The meeting was a follow-up to two meetings held in 2007 during the development of the county's draft Floodplain Management Plan, planner Chris Perez said. At the 1½-hour meeting May 14, county staff provided information on the importance of planning for citizens living or working in flood prone areas.

Gloucester residents may benefit from the meeting in possible future savings on their flood insurance, building official Paul Koll said. Gloucester is presently rated "9"—or the starting level—on the scale, which qualifies homeowners in the floodplain here to receive a 5 percent discount on their flood insurance.

If Gloucester can identify and implement ways to better protect itself against floods in the future, homeowners might be eligible for higher discounts on their flood insurance, Koll said.

The meeting was a chance for staff and residents to talk about how Gloucester County addresses storm events. The dozen or so people who attended the meeting, including a handful of county employees and York district supervisor Teresa Atemus, were encouraged to make favorable comments as well as relate problems they have experienced during past storms, to come up with a better county assistance plans in times of floods.

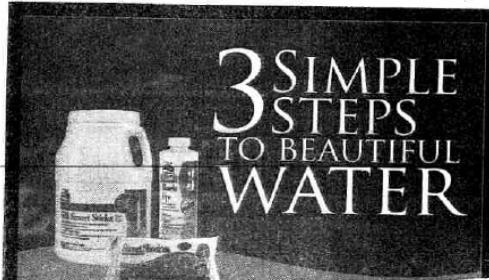
Atemus said that federal stimulus money might be tapped for certain components of the draft plan, such as new emergency warning devices that might be placed in flood-prone areas to alert residents of impending danger.



BILL NACHMAN / GAZETTE-JOURNAL

Chris Perez, a planner in the Gloucester County Planning Department, was one of the speakers during a public information meeting May 14 at Achilles Elementary School about a floodplain management plan. A public hearing on the floodplain plan will be held by the Gloucester Board of Supervisors after this year.

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Source: Gloucester-Mathews Gazette Journal

June 2009 – September 2009 Formal Adoption Process

Appendix H: Board of Supervisor's Resolution Authorizing the Preparation of a Floodplain Management Plan and Establishing a Planning Committee

AT A REGULAR MEETING OF THE GLOUCESTER COUNTY BOARD OF SUPERVISORS, HELD ON TUESDAY, MAY 5, 2009, AT 7:00 P.M., IN THE BOARD ROOM IN THE COLONIAL COURTHOUSE, COURT CIRCLE, 6504 MAIN STREET, GLOUCESTER, VIRGINIA: ON A MOTION DULY MADE BY MR. ALLEN, AND SECONDED BY MS. ALTEMUS, THE FOLLOWING RESOLUTION WAS ADOPTED BY THE FOLLOWING VOTE:

Charles R. Allen, Jr., yes;
Teresa L. Altemus, yes;
Robert A. Crewe, yes;
Michelle R. Ressler, yes;
Christian D. Rilee, yes;
Louise D. Theberge, yes;
Gregory Woodard, yes;

RESOLUTION AUTHORIZING THE PLANNING DEPARTMENT AND THE DEPARTMENT OF CODES COMPLIANCE TO MOVE FORWARD WITH THE PREPARATION OF A FLOODPLAIN MANAGEMENT PLAN THAT MEETS FEMA CRS PROGRAM REQUIREMENTS AND AUTHORIZING THE ESTABLISHMENT OF A PLANNING COMMITTEE TO ANNUALLY EVALUATE AND REVIEW THE PLAN ONCE ADOPTED.

WHEREAS, Gloucester County is a participating community in FEMA's National Flood Insurance Program (NFIP), which allows the county to benefit from the Community Rating System (CRS) program. Under the program, flood insurance premiums are modified based on a point system which calculates the community's efforts to reduce future flood damage in the area beyond the minimal national standards; and

WHEREAS, in 1994, FEMA conducted an analysis of the county's floodplain management efforts, and in 1995 awarded the County a Class 9 rating in the CRS program. The rating directly affects the annual premiums of 1,528 flood insurance policy holders within Gloucester County decreasing premiums by 5 percent; and

WHEREAS, further reductions in flood insurance policy premiums are available to the county through this program; and

WHEREAS, in order to maintain its CRS rating, the county is required to prepare and adopt a flood plain management plan. The purpose of this plan is to document and analyze the county's existing coastal flood management practices and provides feasible solutions to strengthen the county's overall coastal flood management system, helping to lessen the amount of damage caused by coastal flooding; and

WHEREAS, additional CRS credits may be earned through the methods of preparation of the plan by the county including community support, public participation, and monitoring and implementation of the plan; and

WHEREAS, with activities currently being conducted by the county, the anticipated adoption of a flood plain plan and establishment of procedures for monitoring and implementation of the plan, staff anticipates being able to achieve a CRS rating that will reduce flood insurance rates up to 15 percent; and

WHEREAS, in 2007 a draft Floodplain Management Plan ..as prepared as part of a graduate student project with assistance from the departments of Planning, Codes Compliance, Emergency Services, and Information Technology; and

WHEREAS, two public meetings were held at Achilles Elementary School in order to engage the public on the county's flooding issues as well as gain citizen input as to what they would like to see done in the community to remedy the flood problems; and

WHEREAS, CRS officials (ISO Board) reviewed the draft plan and provided the county a list of requirements for approval including the adoption of the plan by the governing body and establishing a program for annual review of the plan's implementation and progress as well as recommendations for additional credits; and

WHEREAS, additional credits may be achieved for the CRS rating if the governing body formally endorses the planning process for the Floodplain Management Plan including establishing who is responsible for preparing the plan and specifying a completion deadline; and

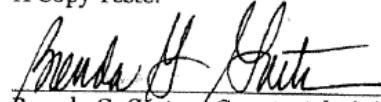
WHEREAS, additional credits may also be achieved by the governing body authorizing the establishment of a planning committee that is charged with monitoring the implementation, reviewing progress and recommending revisions to the plan in an annual report submitted to the governing body, released to the media and made available to the public; and

WHEREAS, the Board of Supervisors finds that these actions will improve the quality of the planning process and its future implementation for the health, safety and welfare of the community, as well as provide additional benefits to its residents through the CRS program.

NOW, THEREFORE, BE IT RESOLVED that the Gloucester County Board of Supervisors authorizes the Department of Planning with assistance from the Department of Codes Compliance to move forward with the preparation of a Floodplain Management Plan to meet the CRS program requirements for adoption by November 2009,

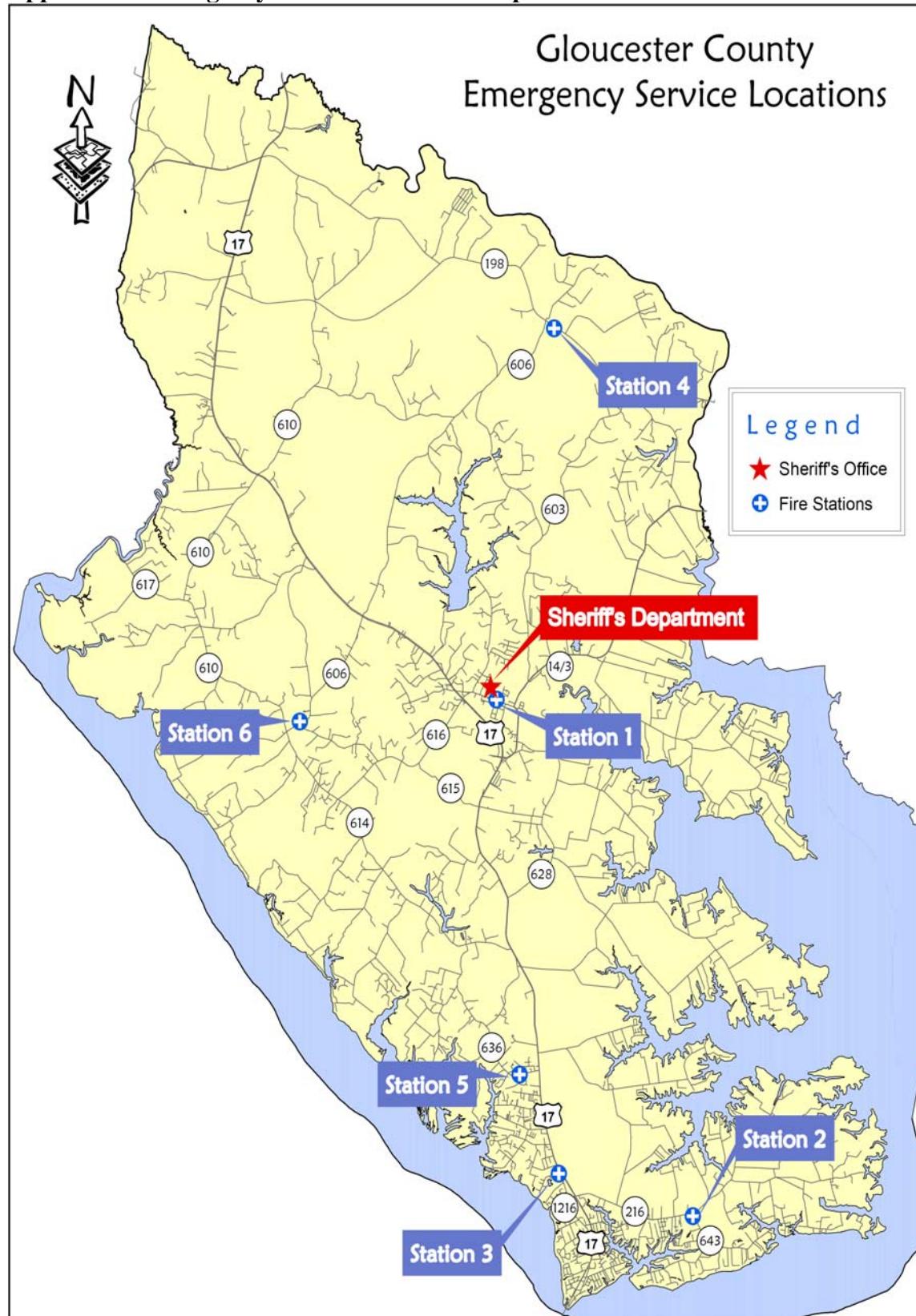
BE IT FURTHER RESOLVED that the Board of Supervisors hereby authorizes the County Administrator to form a Flood Plain Management Planning Committee consisting of at least 16 members to facilitate and annually evaluate and review of the plan once adopted. At least half the committee members of this committee will be members of the public that are residents, business owners or property owners from the flood prone areas. Other members will include a member of the Board of Supervisors, the Building Official and representatives from the Planning Department, Environmental Programs Division of the Department of the Department of Codes Compliance, Department of Emergency Services, Fire and Rescue Departments, Department of Public Works, Parks, Recreation and Tourism and Community Education. Members of the Committee will be appointed upon approval of the plan.

A Copy Teste:



Brenda G. Garton, County Administrator

Appendix I: Emergency Service Locations Map



Source: Gloucester County Information Technology/ GIS Department.